Freedom-to-Operate Intro Scan

Heparin-Coated Coronary Catheter

Case PATTI-FTO-SAMPLE-MED · 2026-07-31 · Patti by Empryon

AI-ASSISTED TECHNICAL ASSESSMENT — NOT A LEGAL OPINION

SAMPLE REPORT — format illustration on a generic example technology. Not a client engagement.

IMPORTANT NOTICE

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The screening is sample-based: only the patents listed in the Search Log and Patents Reviewed sections were examined. Absence of a reference in this report does not mean no relevant patent exists.

Patent numbers, titles, assignees, dates and claims text are retrieved from public sources and each entry carries a link for independent verification. Relevance assessments and observations are AI-generated reasoning and may be wrong.

Consult a registered patent attorney before making any filing, launch, or freedom-to-operate decision.

1. Subject & Standardized Technical Features

Subject under screening (as confirmed by the requester):

A coronary intervention catheter with an anti-thrombogenic coating. The catheter shaft has a polyurethane surface layer to which heparin molecules are covalently bonded to reduce thrombus formation during coronary procedures. The coating is applied by dip-coating the catheter shaft in a heparin-functionalized solution followed by UV curing to fix the covalent bonds. Target market: US.

Stated target market jurisdiction(s): US — deep-review slots are prioritized for patents enforceable there (WO/PCT next); out-of-jurisdiction documents reviewed after. Family members in the target jurisdiction are not resolved by this tier — check via each patent's link.

Feature	Name	Description (claim-comparable)
TF1	Catheter shaft substrate	Coronary intervention catheter shaft with a polyurethane surface layer
TF2	Covalently bonded heparin coating	Heparin molecules covalently bonded to the polyurethane surface layer to reduce thrombus formation
TF3	Dip-coating application method	Coating applied by dip-coating the catheter shaft in a heparin-functionalized solution
TF4	UV curing fixation step	UV curing process used to fix the covalent bonds between heparin and the polyurethane surface
TF5	Anti-thrombogenic functional purpose	Coating designed to reduce thrombus formation during coronary procedures

2. Methodology & Screening Funnel (auditable)

Real patent-database search via Google Patents index. Funnel: 200 unique hits searched → 200 relevance-screened (every hit) → 80 flagged as potentially relevant → 40 claims-reviewed in depth (every one with actual claims text) · 20 flagged hits had unretrievable claims and did not consume review slots (listed below). 120 screened out as low-relevance/irrelevant. Every patent cited below originates from these searches — none are AI-generated.

Query	Hits	Source
catheter polyurethane surface covalently bonded heparin coating	40	searchapi
anti-thrombogenic catheter coating dip-coating heparin UV curing	40	searchapi
coronary catheter heparin immobilization covalent bond polymer surface	40	searchapi
UV cured heparin coating medical device thrombus resistance	40	searchapi
dip coating heparinized catheter shaft anticoagulant surface treatment	40	searchapi
covalent heparin bonding polyurethane catheter anti-clotting coating	40	searchapi

Flagged and prioritized, but claims text could not be retrieved automatically — these did NOT consume deep-review slots (replacements were pulled from the flagged list); review manually via the links:

Patent	Title	Screen relevance
US5135516A	Lubricious antithrombogenic catheters, guidewires and coatings	MEDIUM
US5443455A	Guidewire and method of pretreating metal surfaces for subsequent polymer ...	MEDIUM
US5077372A	Amine rich fluorinated polyurethaneureas and their use in a method to ...	MEDIUM
US5782908A	Biocompatible medical article and method	MEDIUM
US5576072A	Process for producing slippery, tenaciously adhering hydrogel coatings ...	MEDIUM
US6080488A	Process for preparation of slippery, tenaciously adhering, hydrophilic ...	MEDIUM
US5662960A	Process for producing slippery, tenaciously adhering hydrogel coatings ...	MEDIUM
WO2026090506A1	Medical device coatings and methods	HIGH
WO2020212978A1	A lubricious, therapeutic and abrasion-resistant coating for devices and ...	HIGH
WO1998010805A1	Process for preparing polyurethanes grafted with polyethylene oxide chains ...	HIGH
WO2014109824A1	Medical device having a lubricious coating with hydrophilic compounds in an ...	MEDIUM
EP0946218B1	Bonding bio-active materials to substrate surfaces of medical devices via ...	HIGH
CA2866315C	Glycosaminoglycan and synthetic polymer materials for blood-contacting ...	HIGH
JP6599882B2	Implantable medical devices	HIGH
KR102719813B1	Improvements to methods for immobilizing biological entities	HIGH
JP7264581B2	Antithrombotic coating for aneurysm treatment devices	HIGH
CA3105562C	Bioactive coatings	HIGH
JP6388541B2	Surface modification for fluid and solid resilience	MEDIUM
CA2745204C	Layered non-fouling, antimicrobial, antithrombogenic coatings	MEDIUM
KR101648599B1	Medical device which has lubricating surface when wet	MEDIUM

Flagged but not deep-reviewed (over the disclosed review cap of this tier) — listed for transparency; consider a higher tier or manual review:

Patent	Title	Screen relevance

CN114848923B	Dual-modulus multifunctional self-adaptive coating, application thereof and ...	MEDIUM
JP2015167822A	In vivo indwelling object	MEDIUM
CA2743493A1	Surface modification of polymers via surface active and reactive end groups	MEDIUM
JPH10502857A	Method for hydrophilizing hydrophobic polymers	MEDIUM
CA2743493C	Surface modification of polymers via surface active and reactive end groups	MEDIUM
EP2543400B1	Medical device having a lubricious coating with a hydrophilic compound in an ...	MEDIUM
JP7498757B2	Polydopamine and antibody coated medical devices	MEDIUM
CN110545754B	Coated medical devices and use for the treatment or prevention of vascular ...	MEDIUM
CA2211651C	Hydrogel coatings containing a polyurethane-urea polymer hydrogel commingled ...	MEDIUM
EP3397147B1	Medical devices with antithrombogenic coatings	MEDIUM
JP7174712B2	Medical devices coated with polydopamine and antibodies	MEDIUM
JP2013078672A	Multifunctional medical article	MEDIUM
CA2799641C	Articles having non-fouling surfaces and processes for preparing the same ...	MEDIUM
JP7723148B2	Polydopamine and antibody coated medical devices	MEDIUM
JP5554296B2	Implantable medical device	MEDIUM
RU2724446C2	Catheter assembly for treating plaques and a method of treating arterial plaque	MEDIUM
EP2059272B1	Coating formulation for medical coating	MEDIUM
EP2271379B1	Insertable medical devices having microparticulate-associated elastic ...	MEDIUM
CA2212519C	Process for the coating of objects with hyaluronic acid, derivatives thereof, ...	MEDIUM
JP6714043B2	Insertable medical device having an elastic substrate on which microparticles ...	MEDIUM

This is a screening funnel, not an exhaustive legal clearance search.

3. Patents Reviewed (claims-level)

⚠ **AI REASONING — MAY BE WRONG.** The relevance grades, overlap points and distinguishing points below are AI analysis of the actual claims text. Verify each patent via its link before relying on any statement.

3.1 US8263170B2 — Methods for immobilizing anti-thrombogenic material onto a medical device or into a coating thereon

Assignee: Abbott Cardiovascular Systems Inc · Published: 2012-09-11 · Status: Expired - Fee Related · exp. 2021-07-30 · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Fee Related (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1 requires immobilizing an anti-thrombogenic material (e.g., heparin per claim 5) onto a coating on an implantable medical device surface, which broadly overlaps with the invention's covalent heparin bonding to a catheter shaft surface for anti-thrombogenic purposes
- Claim 11's implantable medical device with anti-thrombogenic material attached via the method of claim 1 potentially overlaps with the invention's coated catheter shaft, an implantable medical device bearing heparin
- Claim 5 (heparin as the anti-thrombogenic material) generically overlaps with the invention's specific use of heparin

Appears to differ (AI reasoning):

- Claim 1 requires a reaction between the base coat's chemically functional groups and an excess amine-terminated material (specifically amine-terminated hyaluronic acid or amine-terminated polyvinyl pyrrolidone) as an intermediate linking step; the invention as described does not appear to include this amine-terminated intermediate chemistry, instead describing direct covalent bonding of heparin to a polyurethane surface
- Claim 1 requires a rinsing step with water following the amine-terminated material reaction, which is not described in the invention's process
- Claims 2-4, 6-10 require specific reaction conditions (time, temperature, pH, carbodiimide use) tied to the amine-terminated intermediate chemistry that are not present in the invention's UV-curing-based fixation approach
- The patent's claims are directed to a multi-step base-coat/amine-intermediate immobilization chemistry rather than a UV-curing dip-coat covalent bonding method as used in the invention, suggesting the specific claimed reaction pathway may not be required or practiced by the invention

Note: This patent claims a specific chemical method for immobilizing anti-thrombogenic materials (including heparin) via a polymerized base coat layer reacted with amine-terminated hyaluronic acid or PVP intermediates, followed by rinsing and further reaction with the anti-thrombogenic material. The invention describes a different chemical pathway: direct covalent bonding of heparin to a polyurethane surface via dip-coating and UV curing, without an amine-terminated intermediate or base-coat polymerization step. While both target heparin immobilization on medical devices for anti-thrombogenic purposes (a generic overlap in purpose and material), the claims' specific mandatory steps (base coat polymerization, amine-terminated material reaction, water rinse) constitute required elements not clearly present in the invention's described process. This is an informational screening note only; a full claims-construction and equivalents analysis would be needed to assess actual overlap risk, particularly regarding whether UV curing could be viewed as a form of 'polymerizing' the base coat or whether any amine-based chemistry is implicitly used in the invention's covalent bonding process. ⚠ LEGAL STATUS (Google Patents): Expired - Fee Related — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note claims Claim 11 requires an 'implantable medical device' overlapping the invention's 'catheter shaft' bearing heparin, but does not clarify whether a coronary catheter clearly qualifies as an 'implantable medical device' in the patent's sense—this is a reasonable but slightly loose inference, not directly evidenced.
- The distinguishing points correctly note additional required steps in claim 1 (amine-terminated intermediate, rinsing) absent from the invention, which is legitimate claim-scoping reasoning since claim

1 is a method claim requiring all listed steps; this is not wrong-direction reasoning since the distinction is that the invention lacks required claim elements, not that the claim lacks invention features.

- The note's phrase 'generically overlaps with the invention's specific use of heparin' is a fair characterization given claim 5 explicitly recites heparin as anti-thrombogenic material.
- Overall the note appropriately distinguishes based on affirmatively required method steps in the claims (base coat, amine intermediate, rinsing) rather than absent limitations, so it does not commit the 'claim doesn't recite invention feature' fallacy; but the framing 'the invention does not appear to include this amine-terminated intermediate chemistry' could be seen as slightly hedged/uncertain given no explicit statement in the invention features about absence of amine chemistry, which is a minor unsupported inference.

3.2 US20250325733A1 — Multifunctional Surface Modification of Biomaterials to Reduce Thrombosis

Assignee: McMaster University · Published: 2025-10-23 · Status: Pending · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 broadly covers an antithrombotic surface-modified biomaterial with an antithrombotic agent attached to a bioadhesive-coated substrate; the invention's heparin-coated polyurethane catheter shaft falls within the general antithrombotic/blood-contacting device space this claim family addresses.
- Claim 2 lists polyurethane as an exemplary biomaterial substrate, matching the invention's polyurethane surface layer.
- Claim 7 lists heparin as an exemplary anticoagulant agent, matching the invention's use of heparin.
- Claim 27 lists catheter as an exemplary blood-contacting device, matching the invention's coronary intervention catheter application.
- Claim 13 recites that antithrombotic agents may be 'attached directly' to the coated substrate, which is broad language that could potentially read on covalent heparin attachment depending on how 'bioadhesive coated substrate' is interpreted.
- The overall anti-thrombogenic functional purpose (reducing thrombus formation) aligns with the stated purpose of claims 1, 15, and 26.

Appears to differ (AI reasoning):

- Claim 1 (and all claims depending from it, including device claim 26/27 and method claims 15-25) requires a 'polymerizable dopamine-containing bioadhesive' (e.g., polydopamine or mussel foot protein per claim 5/25) as an intermediate coating layer to which the antithrombotic agent is attached; the invention as described appears to involve heparin covalently bonded directly to the polyurethane surface layer with no dopamine-based bioadhesive intermediate mentioned, which is a required element the invention appears to lack.
- The method claims (15-25) require a two-step process: (i) polymerizing a dopamine-containing bioadhesive onto the substrate, then (ii) contacting that polymerized coating with antithrombotic agent(s); the invention's described process (dip-coating in a heparin-functionalized solution followed by UV curing to fix covalent bonds) does not appear to include a distinct dopamine bioadhesive polymerization step, so this claimed process limitation appears unmet.
- Claim 25 specifically requires the bioadhesive to be polydopamine — a limitation with no apparent counterpart in the invention's disclosed heparin/polyurethane/UV-curing scheme.

Note: This is an informational screening note, not a legal or infringement opinion. The patent's independent claim 1 and its dependents/method claims are structured around a dopamine-containing bioadhesive (e.g., polydopamine) as the attachment platform for antithrombotic agents — a core architectural element not evidently present in the invention's direct covalent heparin-to-polyurethane bonding via dip-coating/UV curing. However, because claim 13 uses broad 'attached directly' language and claims 2/7/27 broadly enumerate polyurethane, heparin, and catheters as options, there is meaningful thematic and material overlap warranting closer comparison of the actual bonding chemistry

and any equivalents analysis, particularly regarding whether UV-cured covalent heparin attachment could be viewed as encompassed by or equivalent to the claimed bioadhesive-mediated attachment mechanism. Full claims text was provided and reviewed in full. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement on Claim 13 is misleading: claim 13 says antithrombotic agents are 'attached directly to the bioadhesive coated substrate,' meaning direct attachment to the dopamine-bioadhesive-coated substrate, not direct attachment to the bare substrate without a bioadhesive; framing this as potentially reading on covalent heparin attachment to polyurethane (with no bioadhesive) overstates the claim's scope since claim 13 still depends on claim 1's bioadhesive requirement.
- The distinguishing points correctly note the missing dopamine-bioadhesive intermediate, which is valid reasoning since narrower claims are less risky; however, the note's closing paragraph frames the absence of the bioadhesive as reducing risk, which is correct for claim 1's specific limitation, but the note does not adequately flag that claim 1 is the broadest independent claim and its dependents (2, 7, 27) are still bound by the bioadhesive requirement, so overlap claims based on claims 2, 7, and 27 alone (without acknowledging they inherit claim 1's bioadhesive limitation) risk overstating overlap breadth.

3.3 US20140272232A1 — Antithrombic coatings and uses thereof

Assignee: Bard Access Systems Inc · Published: 2014-09-18 · Status: Abandoned · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Abandoned (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1 broadly requires an antithrombic coating with an outer layer comprising an anionic antithrombic agent (e.g., heparin per claim 12) interacting with an underlying polymeric layer on a substrate — this generic structure could encompass a heparin-coated catheter shaft substrate as in the invention, though the invention's covalent bonding mechanism differs from the claimed electrostatic interaction (potential overlap with equivalents caution regarding attachment chemistry).
- Claim 15 recites 'a catheter' as a substrate for the coating, which is broad enough to potentially read on the invention's coronary intervention catheter shaft.
- Claim 12 recites 'heparin' as the outer antithrombic layer, overlapping with the invention's heparin coating in a general functional/material sense.
- Dip-coating as an application method (claim 17/19) overlaps generically with the invention's dip-coating application step, though the claimed dipping sequence is tied to a specific multi-layer electrostatic build process.

Appears to differ (AI reasoning):

- Claim 1 requires a specific multi-layer architecture (first cationic layer, second anionic layer, penultimate cationic layer, outer antithrombic layer) built through electrostatic (ionic) interactions between alternating cationic/anionic polymer layers — the invention as described appears to use a single covalent heparin-polyurethane bond without this layered electrostatic polyelectrolyte assembly, which the claim requires.
- Claims 2, 3, 5, and related dependent claims require specific synthetic cationic/anionic polymer species (e.g., polylysine, polyethylenimine, poly(acrylic acid)) forming the underlying layers — the invention's polyurethane surface layer with direct covalent heparin attachment does not appear to include these required intermediate polymeric layers.
- Claim 17/19 methods require a specific sequence of dips including an ammonium persulfate treatment step and formation of multiple alternating cationic/anionic layers prior to antithrombic agent binding — the invention's disclosed method (dip-coating in heparin-functionalized solution followed by UV curing) does not appear to include this required multi-step layered electrostatic deposition process.

- The claimed outer layer attachment relies on electrostatic interaction with the penultimate cationic layer, whereas the invention specifies covalent bonding fixed via UV curing — this is a required limitation (electrostatic binding mechanism and specific layer interaction) that the invention's described chemistry does not appear to satisfy as claimed.

Note: This patent's claims are directed to a specific multi-layer polyelectrolyte (alternating cationic/anionic) coating architecture terminating in an antithrombic outer layer bound via electrostatic interaction, applied to a broad class of substrates/devices including catheters, with a corresponding multi-step dip-based manufacturing method. The invention's single covalently-bonded heparin-on-polyurethane coating with UV-curing fixation shares the general goal (anti-thrombogenic catheter coating) and the dip-coating application concept, creating some potential overlap at a high level, but the claims as written impose specific structural requirements (multiple distinct polymer layers, electrostatic rather than covalent binding, specific process steps like ammonium persulfate treatment) that do not appear to be present in the invention as described. This is an informational screening note only, not a legal or infringement conclusion; a full claim-construction and prosecution-history review would be needed for any definitive assessment. ⚠ LEGAL STATUS (Google Patents): Abandoned — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

3.4 US9127091B2 — Heparin coatings

Assignee: BioInteractions Ltd · Published: 2015-09-08 · Status: Expired - Lifetime · exp. 2023-05-22 · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Lifetime (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1 broadly claims a method of preparing a medical device coating by exposing the device to a solution comprising a heparin macromer (heparin methacrylate or related derivative) and a heat-initiated crosslinker, then heating to covalently crosslink the polymer to the surface — this generically covers forming a covalently bonded heparin coating on a device surface, which overlaps with the invention's covalently bonded heparin coating on the catheter shaft for anti-thrombogenic purposes
- Claim 5 explicitly lists 'catheter' as a medical device to which the claimed coating method may be applied, overlapping with the invention's coronary intervention catheter shaft substrate
- The claimed exposure of the device to a heparin-containing solution to form a layer is a generic solution-application step that could encompass dip-coating as one method of 'exposing' the device, representing a potential overlap

Appears to differ (AI reasoning):

- Claim 1 requires the first polymer to be a copolymer of a specific heparin macromer (heparin methacrylate, heparin quaternary ammonium salt complex methacrylate, heparin methacrylate salt, or heparin PEG methacrylate) crosslinked via a 'polymeric heat-initiated crosslinker' — the invention as described does not specify use of such methacrylate-based heparin macromers or a polymeric heat-initiated crosslinker
- Claim 1 requires curing/fixation by heating to effect crosslinking, whereas the invention uses UV curing to fix covalent bonds; this is a different crosslinking mechanism (heat-initiated vs. UV-initiated) and does not appear to fall within the literal 'heat-initiated' limitation, though equivalents should be considered

Note: This informational screening compares claim language to the invention description only; it is not a legal or infringement opinion. The patent's independent claim 1 is broad in defining the medical device coating method and heparin macromer chemistry, and separately claims catheters as a covered device type, creating potential overlap in subject matter (covalent heparin-device coatings for anti-thrombogenic use). However, claim 1's specific requirement of a heparin methacrylate-type macromer combined with a 'polymeric heat-initiated crosslinker' and heat-based curing appears to differ from the invention's UV-curing-based fixation approach, which is not addressed by the claims. No claim language addresses dip-coating specifically, nor does it exclude it, so this method step is not a distinguishing basis. Because the

invention lacks detail on macromer/crosslinker chemistry, a more thorough chemical comparison would be needed for a definitive overlap assessment. ⚠ LEGAL STATUS (Google Patents): Expired - Lifetime — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement claiming the invention's coating is for 'anti-thrombogenic purposes' overlapping with claim 1 is a slight overstatement, since claim 1 itself does not recite an anti-thrombogenic purpose (that's only in the title/abstract framing of heparin coatings, not the claim language).
- The distinguishing point about UV curing vs heat-initiated crosslinking is valid, but the note frames the invention's lack of a specified macromer/crosslinker chemistry as a distinguishing factor while also acknowledging claim 1 is broad and generic; this is somewhat contradictory but not wrong-direction since it correctly notes broad claim 1 as overlap risk.
- The statement 'No claim language addresses dip-coating specifically, nor does it exclude it, so this method step is not a distinguishing basis' is correct reasoning (broad claims not excluding dip-coating means it doesn't distinguish), so this is faithful, but the earlier distinguishing bullet about macromer/crosslinker chemistry not being specified in the invention borders on wrong-direction reasoning: the invention's lack of detail on chemistry doesn't establish that it differs from the claim, yet it's used to distinguish, which understates the overlap risk rather than being a true distinguishing feature.

3.5 US11850331B2 — Devices with anti-thrombogenic and anti-microbial treatment

Assignee: Teleflex Medical LLC · Published: 2023-12-26 · Status: Active · exp. 2034-03-10 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both relate to catheter/tubular medical devices with coatings intended to reduce thrombogenic events (claim 1, 6-9), which is a shared functional purpose area
- Claim 17 recites a coating comprising polyurethane (various types) in addition to the required alexidine coatings, which broadly overlaps with the invention's polyurethane surface layer as a substrate/coating material

Appears to differ (AI reasoning):

- Claim 1 requires an external coating or impregnation comprising alexidine at 200-300 µg/cm2, and an internal coating or impregnation with a lower alexidine concentration than the external one; the invention's coating is heparin, not alexidine, and the invention does not describe a two-tier (external vs. internal) concentration-differentiated coating scheme
- Claim 23 requires that the external and internal coatings not include an anti-thrombogenic agent other than alexidine, which would exclude heparin as the active agent used in the invention
- Dependent claims 4, 5, 7-14, 16, 18-22 all build on the alexidine-specific and external/internal concentration-differential limitations of claim 1, none of which are present in the invention's single covalently-bonded heparin coating via dip-coating/UV curing
- The claims do not reference or require a dip-coating application method or a UV curing step to fix covalent bonds, and there is no claim limitation directed to a covalent bonding mechanism between the active agent and the substrate — the patent's claims are silent on the invention's specific process steps, but since the claims' core requirement (alexidine as the active agent, in specific internal/external concentration relationship) is not met by the invention, this is a genuine missing-element difference rather than mere absence of extra detail

Note: This patent's claims are centered on a dual (external/internal) alexidine-based anti-thrombogenic/anti-microbial coating scheme with specific concentration ranges and differentials (claim 1 and dependents). The invention describes a heparin-based, covalently bonded coating on a polyurethane catheter shaft applied via dip-coating and UV curing — a different active agent (heparin vs. alexidine) and a different structural approach (single covalent heparin layer vs. differentiated internal/external alexidine concentrations). Overlap is limited to the shared general context of anti-

thrombogenic coatings on tubular medical devices and the generic reference to polyurethane coatings in dependent claim 17. Because claim 1's alexidine-concentration and internal/external differential limitations appear to be required elements absent from the invention, and claim 23 affirmatively excludes non-alexidine anti-thrombogenic agents, overall relevance is assessed as low. This is an informational screening note only, not a legal or infringement opinion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note explicitly states claim 23 requires exclusion of non-alexidine anti-thrombogenic agents and treats this as a valid distinguishing point in the invention's favor for FTO purposes, but this is actually reasoning in the correct direction for claim 23 specifically since it's a narrowing exclusion — however the broader distinguishing logic elsewhere in the note ('claims do not reference or require a dip-coating application method or a UV curing step... the patent's claims are silent on the invention's specific process steps') initially raises absence-of-limitation as a point before correctly self-correcting to note this alone is not distinguishing since claim 1's core requirement is still missing; this self-correction is appropriate but the initial framing risks confusing absence of a limitation with non-infringement, which is border-line wrong-direction reasoning even though the note ultimately clarifies it correctly.
- The claim 17 overlap statement is somewhat overstated: claim 17 depends on claim 1 and merely adds an optional polyurethane coating limitation to a device already requiring alexidine per claim 1; describing this as broadly overlapping with the invention's polyurethane substrate is a stretch since the invention's polyurethane is the shaft surface layer itself, not an added coating layer within an alexidine-based device, so equating the two materials without qualification slightly overstates the similarity.

3.6 US8308699B2 — Layered non-fouling, antimicrobial antithrombogenic coatings

Assignee: Arrow International LLC · Published: 2012-11-13 · Status: Expired - Fee Related · exp. 2030-07-30 · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Fee Related (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1/3 broadly covers a polyurethane-based medical device substrate with a coating covalently bound via complementary reactive functional groups, which overlaps with the invention's polyurethane catheter shaft bearing a covalently bonded coating.
- Claim 22 recites the composition being anti-thrombogenic, overlapping with the invention's stated anti-thrombosis purpose.
- Claim 24/28 cover vascularly inserted catheters as the medical device, which is broad enough to potentially encompass a coronary intervention catheter.
- The general concept of covalent bonding between a functional coating and a polymeric substrate (claim 1, 26) overlaps with the invention's covalent heparin-to-polyurethane bonding mechanism.

Appears to differ (AI reasoning):

- Claim 1 (and dependent claims) require a two-layer architecture: a polymeric undercoat immobilized on the substrate plus a separate non-fouling polymeric topcoat copolymer covalently bound to that undercoat via complementary reactive functional groups; the invention as described appears to bond heparin directly to the polyurethane surface without an intermediate polymeric undercoat layer.
- Claim 1 requires that more than 35 mole % of the polymerized monomers of the topcoat copolymer be polyether moieties or phosphorylcholine/sulfobetaine/carboxybetaine zwitterionic moieties; heparin is a sulfated polysaccharide and is not described as such a copolymer, so this specific compositional limitation does not appear to be met.
- Claims 4/5/31 specify particular complementary reactive functional group chemistries (e.g., epoxy-amine, isocyanate-carboxyl, silanol-silanol); the invention's heparin-functionalized dip-coating/UV-curing chemistry is not described in these terms, so alignment with this specific limitation is unclear.

- Method claim 26 requires immobilizing a polymeric undercoat with reactive functional groups and then grafting the zwitterionic/polyether topcoat to it; the invention's process (dip-coating in heparin solution followed by UV curing) does not appear to include a distinct undercoat-immobilization step as claimed.

Note: This is an informational screening comparison only, not a legal or infringement conclusion. The patent's claims are directed to a specific layered architecture (functionalized substrate + polymeric undercoat + non-fouling zwitterionic/polyether topcoat copolymer) rather than a direct heparin coating. While there is conceptual overlap around polyurethane substrates, covalent surface bonding, and anti-thrombogenic function, the core compositional limitation (>35 mole% polyether or zwitterionic monomers in the topcoat) and the required undercoat layer appear to be missing from the described heparin-based invention, which relies on a different biomolecule (heparin) and a single-layer covalent attachment. Equivalents analysis was not performed; a full claim chart against the actual heparin chemistry and undercoat presence/absence would be needed for a definitive assessment. ⚠ LEGAL STATUS (Google Patents): Expired - Fee Related — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement citing 'Claim 1/3 broadly covers... a coating covalently bound via complementary reactive functional groups, which overlaps with the invention's polyurethane catheter shaft bearing a covalently bonded coating' is somewhat overstated since claim 1 requires a specific two-layer undercoat+topcoat architecture with >35 mole% polyether/zwitterionic monomers, not a generic covalent coating; the note does later clarify this in distinguishing points, but the initial overlap framing risks overstating similarity.
- The distinguishing point about claim 26 requiring 'immobilizing a polymeric undercoat... and then grafting the topcoat' contrasted with the invention lacking 'a distinct undercoat-immobilization step' is legitimate, but combined with claim 1's compositional limitation, the note correctly treats this as narrowing (correct direction), not fabricated.
- Legal status statement (Expired - Fee Related) is not supported by any of the provided evidence (title, abstract, claims) and appears to be an unverified addition outside the given materials, though flagged appropriately with a caveat to check further.

3.7 USRE45500E1 — Polymeric network system for medical devices and methods of use

Assignee: BioInteractions Ltd · Published: 2015-04-28 · Status: Expired - Lifetime · exp. 2026-04-20 · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Lifetime (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1 covers a coating on a catheter (device list explicitly includes 'a catheter'), so the general concept of a functional coating applied to a catheter shaft falls within the broad device scope of the claim.
- Dependent claims 25-30 describe a second layer that is covalently crosslinked to a first polymer layer, where the second layer comprises a heparin macromer and forms covalent crosslinks 'in response to exposure to light' (claim 29) — this is conceptually close to the invention's UV-curing step used to fix covalent heparin bonds to the polyurethane surface, raising a potential overlap on the crosslinking-heparin-via-light-exposure mechanism.
- Claim 39 explicitly lists heparin as an anti-thrombogenic therapeutic agent usable in the coating, overlapping with the invention's anti-thrombogenic functional purpose.

Appears to differ (AI reasoning):

- Claim 1 requires the base coating to be a 'thermoplastic copolymer free of covalent crosslinks' with a defined weight-averaged molecular weight (>=2500) and composed of a first and second monomer unit whose homopolymer glass transition temperatures differ by at least ~30°C (with

overall copolymer Tg between -70°C and 70°C). The invention's polyurethane surface layer with covalently bonded heparin does not describe any such dual-monomer thermoplastic copolymer architecture or Tg-based composition, so this core structural limitation of claim 1 does not appear to be addressed by the invention as described.

- The independent claim 1 base layer must be 'free of covalent crosslinks,' whereas the invention's core feature is heparin covalently bonded (crosslinked) directly to the polyurethane surface itself — if this bonding is understood as forming crosslinks within the base coating layer (rather than a separate second layer as in claim 22/25 dependent structure), this appears to conflict with claim 1's explicit non-crosslinking requirement for the base thermoplastic layer.
- The patent's covalent-crosslink/light-cured heparin embodiments (claims 25-30) are only reached via dependency from claims 1 and 22, meaning they require the base first-layer thermoplastic copolymer (with the specific monomer/Tg composition) to also be present; the invention's description (polyurethane surface, dip-coating, UV curing) does not mention a distinct first thermoplastic copolymer layer meeting those compositional limitations, which is a missing-element concern for full claim coverage.
- Claim 1 requires the composition to include 'the therapeutic agent associated with' the copolymer as a drug-delivery matrix; the invention's heparin coating is described purely as a surface-bound anti-thrombogenic layer via dip-coating/UV curing, not clearly as a therapeutic-agent-eluting association with a thermoplastic copolymer matrix as claimed.

Note: This is an informational screening note only. The patent's independent claim 1 is centered on a specific thermoplastic copolymer chemistry (dual monomer units with a defined glass-transition-temperature offset, free of covalent crosslinks) used as a drug-delivery matrix, which is structurally different from the invention's simpler polyurethane-plus-covalently-bonded-heparin surface treatment. However, dependent claims 25-30 (covalent crosslinking between a heparin-macromer-containing second layer and a base layer, cured via light/UV exposure) describe a mechanism conceptually similar to the invention's UV-curing step for covalent heparin bonding, warranting closer review including doctrine-of-equivalents considerations. Full claims text was provided and reviewed verbatim through claim 39 (text truncated at the therapeutic agent list); no claims appear missing that would materially change this assessment for claims 1-39. ⚠ LEGAL STATUS (Google Patents): Expired - Lifetime — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The claim 29/30 light-cured crosslink is specifically described as forming in response to exposure to 'light' with the functional group being 'azide' (claim 30) - the note's characterization as 'UV-curing' is an inference not explicitly stated in the provided claim text, which only says 'light' generically; this is a minor overstatement of specificity.
- The distinguishing point about claim 1 requiring the base layer to be 'free of covalent crosslinks' being in tension with the invention's covalent heparin bonding is a reasonable structural distinction, but the note's own framing acknowledges ambiguity ('if this bonding is understood as...') which is appropriately hedged, not a fabrication.
- The note's overall analysis correctly notes claim 1 is broad in device scope (including catheters) which is properly treated as raising overlap risk rather than distinguishing away from it, so no wrong-direction reasoning is present on that point.
- The distinguishing points reasonably rely on structural mismatches (Tg-based copolymer composition, drug-delivery matrix association, missing first-layer thermoplastic copolymer) that are explicitly required by claim 1, and these are appropriately used to show non-overlap due to additional limitations in the claim not met by the invention - this is correct-direction reasoning (invention lacks a required element), not wrong-direction reasoning.

3.8 US10266620B2 — Coating agents and coated articles

Assignee: Innovative Surface Technologies LLC · Published: 2019-04-23 · Status: Active · exp. 2030-12-21 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 recites a method of applying a coating composition to a device surface and exposing it to actinic energy (UV falls within this generic category) to covalently couple the coating to the surface — this broad photoreactive-crosslinking approach could encompass the invention's UV-curing step used to fix heparin bonds, though the chemistry differs (polymaleic acid derivative/photoreactive groups vs. heparin functionalization).
- Claim 13/17 lists polyurethane as an exemplary substrate material for the coated medical device, overlapping generically with the invention's polyurethane catheter shaft substrate.
- Claim 5/6 and claim 19 contemplate disposing an 'active agent coating layer' including anti-thrombosis agents on the base coating — heparin as an anti-thrombogenic agent could fall within this broadly claimed category of active agent layers.
- Claim 14 describes a multilayer coating with a base coating layer and additional layers, which broadly could read on a construction involving a functionalized base layer plus a bioactive (heparin) layer, though the specific chemistry differs.
- Method dip-coating is not excluded by claim 1's generic 'applying a coating composition' step, so the invention's dip-coating application could fall within this broad application step language.

Appears to differ (AI reasoning):

- Claim 1 requires the coating composition to comprise a polymer that is a polymaleic acid derivative or copolymer thereof with pendent photoreactive groups selected from a specific list (acetophenone, benzophenone, anthrone, acridone, xanthone, thioxanthone, anthraquinone) and anionically charged moieties within the polymaleic acid derivative — the invention's heparin-functionalized coating does not appear to include this specific polymer chemistry or these specific photoreactive groups.
- Claim 1 requires 'anionically charged moieties' as a structural element of the coating composition; the invention's description centers on heparin covalently bonded to polyurethane without describing this anionic-moiety structural requirement.
- Claims 14-20 (article claims) require the multilayer coating to include a hydrophobic coating layer as a mandatory second layer; the invention's coating is described as a single heparin layer covalently bonded to polyurethane, with no indication of a required hydrophobic overcoat.
- Claim 12 requires the coated article be 'prepared by the method of claim 1,' which itself requires the specific polymaleic acid/photoreactive-group chemistry — the invention's heparin-functionalized dip-coating process does not appear to use this claimed chemical pathway.

Note: This patent claims a specific coating chemistry platform (polymaleic acid derivative polymers bearing defined photoreactive aryl-ketone groups and anionic moieties, crosslinked via actinic/UV energy), onto which additional active-agent or hydrophobic layers may be added. The invention's direct covalent heparin-to-polyurethane bonding via UV curing does not clearly use the same photoreactive polymer backbone or anionic-moiety chemistry specified in claim 1, which is a structural prerequisite of the independent claims. However, the claims are broad enough in the 'applying a coating' and 'active agent layer' language that a heparin-containing active-agent overlayer or an actinic (UV)-cured covalent attachment step could show overlap if the invention's chemistry happens to involve any anionically-charged photoreactive polymaleic intermediate — this would need review of the invention's actual coating chemistry beyond what is summarized. Overall relevance is medium: the technology field (covalent surface coatings for medical devices, including polyurethane substrates and anti-thrombotic active agents) aligns, but the specific claimed polymer/photoreactive chemistry appears distinct from a heparin-polyurethane covalent system. This is an informational screening note only, not a legal or infringement opinion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The claim 14 overlap statement mischaracterizes claim 14 as merely 'a base coating layer and additional layers' broadly, when claim 14 actually mandates specific structural requirements (polymaleic acid derivative, aryl ketones, anionically charged moieties, plus a hydrophobic layer) — the note's framing

downplays this specificity in the overlap section while correctly noting it in distinguishing points, creating some inconsistency.

- The distinguishing point about claim 14-20 requiring a mandatory hydrophobic layer while the invention lacks one is technically accurate as a difference, but claim 1 (the core method claim) does not require a hydrophobic layer, so using this only against claims 14-20 is fine, though the note should be clearer that claim 1 itself is not limited by this feature.
- The statement 'Method dip-coating is not excluded by claim 1's generic applying a coating composition step, so the invention's dip-coating could fall within this broad application step' is a legitimate overlap argument (broad claim language can encompass narrower species), which is correctly reasoned in the FTO-cautious direction and not flagged as an issue, but is included here for completeness of review.
- The note's distinguishing arguments consistently and correctly focus on claim 1's affirmative structural requirements (specific polymer chemistry, specific photoreactive groups, anionic moieties) being absent from the invention, rather than arguing distinction merely because the claim fails to recite invention features — this is correct-direction reasoning, but the note should be scrutinized to ensure claim 12's dependency on claim 1's chemistry is not overstated as a complete distinguishing point, since claim 12 is narrower and does not represent the broadest claim risk (claim 1 method claim is the broader risk, correctly analyzed).

3.9 US20220218879A1 — A lubricious, therapeutic and abrasion-resistant coating for devices and methods for producing and using thereof

Assignee: Israel Plastics and Rubber Center Ltd · Published: 2022-07-14 · Status: Abandoned · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Abandoned (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 26 broadly covers coating a polyurethane surface of an insertable medical device with a therapeutic/antithrombogenic compound via covalent bonding (thiol-ene click chemistry), which overlaps generically with the invention's concept of covalently bonding an antithrombogenic (heparin) coating to a polyurethane catheter surface
- Claim 33 covers 'an insertable medical device having a polyurethane surface coated according to the method of claim 26,' which could generically encompass a coronary catheter shaft bearing a covalently-attached antithrombogenic coating, if any overlapping chemistry were used
- The functional purpose recited in claim 26 (producing a therapeutic/antithrombogenic coating to reduce thrombus formation) aligns with the invention's anti-thrombogenic functional purpose

Appears to differ (AI reasoning):

- Claim 26 requires a specific direct thiolization chemistry (secondary amine + ethylene sulphide reaction to form free thiol groups) as the mechanism for covalent attachment; the invention's description of heparin covalently bonded to polyurethane does not indicate use of thiol-ene chemistry or ethylene sulphide-based thiolization, so this specific chemical mechanism appears absent
- Claim 26 requires reacting the thiolated surface with a compound having a vinyl/methacrylate functional group via thiol-ene click reaction; the invention uses heparin functionalization without indication of a vinyl/methacrylate group or click chemistry, so this limitation appears unmet
- Claims 34, 41, and 44 require use of a polyethyleneimine (PEI or PEI-SH) intermediate stock product or isocyanate-functionalized surface for attachment; the invention's dip-coating/UV curing process does not describe a PEI-based conjugate or isocyanate functionalization step
- The invention's specific dip-coating application and UV curing fixation steps are not recited or required by any claim; while these do not create differences on their own (added features cannot avoid a claim), the claims independently require the thiol-ene/thiolization chemistry described above, which the invention's UV-cured dip-coating process does not appear to use as its bonding mechanism

Note: This is an informational overlap screening, not a legal or infringement opinion. The patent's independent claims (26, 34, 41, 44) are narrowly drawn around a specific chemistry: direct thiolization of polyurethane via secondary amine + ethylene sulphide, followed by thiol-ene click reaction with a vinyl/methacrylate-functionalized therapeutic compound (or PEI-mediated conjugates). The invention describes covalent heparin bonding via dip-coating and UV curing, without indication of thiolization, ethylene sulphide, vinyl/methacrylate chemistry, or PEI intermediates. Because the claims require a specific covalent-bonding chemical mechanism rather than covalent bonding generically, overlap depends heavily on the actual chemical mechanism used for heparin attachment in the invention — if heparin lacks a vinyl/methacrylate group and no thiolation/click chemistry is used, overlap is likely low; however, if any thiol-ene or amine-thiol reaction pathway is involved, closer review of equivalents would be warranted. Full claims text was reviewed as provided. ⚠ LEGAL STATUS (Google Patents): Abandoned — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement characterizing claim 26 as 'broadly covering' covalent bonding of a therapeutic/antithrombogenic compound is somewhat overstated: claim 26 is not generic covalent bonding but a specific chemical mechanism (secondary amine + ethylene sulphide thiolization, then thiol-ene click with a vinyl/methacrylate compound); describing this as 'overlapping generically' with the invention's covalent bonding concept risks overstating the breadth of the claim before the distinguishing analysis clarifies the specificity.
- The claim 33 overlap statement includes a hedge ('if any overlapping chemistry were used') that is reasonable and supported, but the initial framing that it 'could generically encompass a coronary catheter shaft' slightly overstates claim scope since claim 33 is explicitly tied to the method of claim 26's specific chemistry, not any covalent bonding.
- The note's final synthesis paragraph appropriately notes chemistry-specific narrowness, which is correct direction (narrower claim recitations reduce overlap risk, not increase it), so no wrong-direction FTO logic is present; this is a genuine strength, not an issue.

3.10 US6338904B1 — Polymer coatings grafted with polyethylene oxide chains containing covalently bonded bio-active agents

Assignee: Boston Scientific Scimed Inc · Published: 2002-01-15 · Status: Expired - Lifetime · exp. 2016-11-25 · Relevance: HIGH · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Lifetime (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1/11 broadly claims a medical device with a hydrophobic polymer backbone (claim 3/13 specifies poly(urethane), including poly(etherurethane)urea) bearing a pendant hydrophilic spacer covalently bonded to the backbone via a reactive functionality (isocyanate, carboxyl, amine per claim 4/14) — this generic architecture could encompass a polyurethane catheter shaft with a covalently attached heparin-bearing coating layer.
- Claim 8-10 and 18-19 recite a bio-active agent that is an anti-thrombogenic agent, specifically heparin or aldehyde-terminated heparin, covalently bonded via the spacer — directly overlapping with the invention's covalently bonded heparin coating intended to reduce thrombus formation.
- Claim 2/12 lists 'arterial vascular access catheters' and similar catheter devices as within the claimed medical device genus, which could read on a coronary intervention catheter shaft.
- Claim 11 recites a process of providing a backbone, providing a spacer, reacting the spacer to the backbone, and covalently bonding a bio-active agent to the spacer — a broad process claim that could overlap with the invention's coating formation steps even though solvent/dip-coating specifics are not recited (broad process claims are not narrowed by the invention's more specific dip-coating step).

Appears to differ (AI reasoning):

- Claims 1 and 11 require a hydrophilic spacer group (e.g., amine-terminated PEO per claim 7/17) interposed between the backbone and the bio-active agent, tethering the agent at a 'bio-effective distance' via hydrophobic/hydrophilic repulsion — the invention as described appears to involve heparin covalently bonded directly to the polyurethane surface layer without an explicit intervening hydrophilic spacer, which could be a missing element if no spacer chemistry is present.
- Claim 11(d) specifies the bio-active agent is linked to the spacer via an amide bond specifically — the invention does not specify the chemical bond type, so this specific linkage requirement is not clearly met.

Note: This patent's claims are broadly drafted around a generic polymer-backbone/spacer/bio-active-agent architecture, explicitly covering poly(urethane) backbones, heparin as the bio-active agent, and catheter-type medical devices, all of which show strong topical overlap with the invention's covalently bonded heparin-on-polyurethane coating for thrombus reduction. The key claim structure (independent claims 1 and 11) requires a hydrophilic spacer group linking the backbone to the bio-active agent; if the invention's covalent heparin bonding lacks any such spacer (i.e., heparin is bonded directly to polyurethane), this could be a basis for distinguishing, though under equivalents doctrine a short/functional spacer moiety might still be found overlapping. Dip-coating and UV-curing process specifics are not addressed by the claims and should be treated as neutral, not as differentiators. This is a screening note only, not a legal or infringement conclusion. ⚠ LEGAL STATUS (Google Patents): Expired - Lifetime — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap bullet on claim 11 explicitly argues that 'broad process claims are not narrowed by the invention's more specific dip-coating step' and treats the absence of dip-coating specifics in the claim as increasing overlap risk — this is actually correct FTO direction (broader claim = more dangerous), so it is not an error, but the note is inconsistent because elsewhere it treats absence of features in the invention (spacer, amide bond) as distinguishing, which is the correct direction for those since the CLAIM requires an element the invention arguably lacks; however the note should be scrutinized for whether it conflates 'claim requires spacer' (a genuine distinguishing feature if invention truly lacks it) versus wrongly asserting narrowing that doesn't exist.
- The distinguishing point about the amide bond in claim 11(d) is a valid narrowing element correctly used, but the note hedges with 'the invention does not specify the chemical bond type, so this requirement is not clearly met' — this is an appropriately cautious framing, not an overstatement, but it borders on assuming absence rather than confirming it, which is speculative given the invention description does not address bond chemistry at all.
- The final synthesis paragraph correctly notes that dip-coating/UV-curing are neutral and not differentiators, which is faithful, but earlier the distinguishing section does not raise UV-curing or dip-coating as false distinguishers, so no wrong-direction issue there — this is fine.
- Overall the spacer-based distinguishing argument is reasonably grounded in claim text (claims 1/11 require a hydrophilic spacer at a 'bio-effective distance'), and the invention features describe heparin bonded directly to the polyurethane surface without mention of a spacer, so this is a legitimate distinguishing point rather than fabrication, but it rests on an assumption (absence of spacer) not explicitly confirmed by the invention description, making it slightly overstated as a firm distinguisher rather than a possible one.

3.11 US20200316268A1 — Immobilising biological entities

Assignee: Carmeda AB · Published: 2020-10-08 · Status: Abandoned · Relevance: MEDIUM · verify on Google Patents ↗

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Potential overlap (AI reasoning):

- Claim 1 broadly requires 'a solid object having a surface' with a coating where covalently bound anticoagulant entity is present in the outer layer — the invention's catheter shaft with covalently bonded heparin on its surface could fall within this generic 'solid object' language.
- Claim 25 specifies the anticoagulant entity is a heparin moiety, directly overlapping with the invention's use of heparin as the anti-thrombogenic agent.
- Both the claims and the invention share the general functional concept of a surface coating with covalently bound heparin intended to impart anticoagulant/anti-thrombogenic properties.

Appears to differ (AI reasoning):

- Claim 1 (and claims 2, 3, 44, 47) require a specific layered architecture of alternating cationic and anionic polymer layers, with the anticoagulant covalently bound to an outer cationic polymer layer — the invention as described uses a single polyurethane surface layer directly functionalized with heparin, with no disclosed cationic/anionic polymer layering structure.
- Claim 1 requires the anionic polymer have a specific total molecular weight range (20 kDa–650 kDa) and a solution charge density of ≤4 μeq/g — the invention description contains no anionic polymer layer or corresponding molecular weight/charge density parameters.
- Claims 2 and 3 require a specific multi-step deposition process (sequential cationic/anionic polymer treatments followed by anticoagulant attachment) — the invention's process is described as a single dip-coating step in a heparin-functionalized solution followed by UV curing, which does not appear to include the claimed layer-by-layer polymer deposition steps.
- Claim 4 narrows the anionic polymer to dextran sulfate, and claims 5-8, 11, 14, 19 add further specific compositional/process limitations (molecular weight subranges, salt concentration, polyamine cationic polymer) that presuppose the layered cationic/anionic architecture absent from the invention's disclosed structure.

Note: Based solely on the verbatim claims provided. Independent claims 1, 2, 3, 44, and 47 all require a layered cationic/anionic polymer coating architecture (with specific anionic polymer molecular weight and charge density parameters) as a structural predicate for the covalently bound anticoagulant/heparin outer layer. The invention as described is a direct polyurethane-to-heparin covalent bonding via dip-coating and UV curing, without any indicated cationic/anionic layered polymer system. This is a potentially significant structural distinction, though if the invention's polyurethane surface or coating process were later shown to incorporate an equivalent cationic layer functioning to anchor heparin, overlap risk would increase. Heparin as the anticoagulant entity (claim 25) is a point of conceptual overlap with the invention's core purpose. This is an informational screening note only, not a legal or infringement conclusion. ⚠ LEGAL STATUS (Google Patents): Abandoned — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement regarding claim 1 describes covalently bound anticoagulant entity in the outer layer generically as 'the invention's catheter shaft with covalently bonded heparin on its surface could fall within this generic solid object language' — this glosses over the fact that claim 1 requires the specific layered cationic/anionic architecture, which the note itself later acknowledges as absent from the invention; presenting it as overlap while also using its absence as a distinguishing point is somewhat inconsistent, though the note does clarify this later.
- The distinguishing points repeatedly rely on the invention's disclosure lacking a cationic/anionic layered structure to conclude non-overlap; this is reasonable claim construction analysis (since claim 1 affirmatively requires this structure, its absence in the invention is a valid non-infringement argument going the correct direction — the invention lacks a required claim element, which is proper FTO reasoning, not reasoning that a narrower invention feature is unclaimed) — however the note frames this multiple times as if the invention 'not having' the layered structure is what avoids the claim, which is actually correct directionally since the layered structure is a required limitation of the claim, not an optional feature the claim fails to recite, so this is not a wrong-direction FTO error.
- The characterization of claims 4-8, 11, 14, 19 as 'presupposing the layered cationic/anionic architecture absent from the invention' is accurate to the claims but somewhat repetitive/overstated in emphasis without adding new distinguishing substance beyond claim 1's analysis.

3.12 US6306176B1 — Bonding layers for medical device surface coatings

Assignee: Surgical Specialties Corp Ltd · Published: 2001-10-23 · Status: Expired - Lifetime · exp. 2017-01-27 · Relevance: MEDIUM · verify on Google Patents ↗

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Potential overlap (AI reasoning):

- Claim 16 broadly covers catheters as the medical device type, which encompasses the invention's coronary intervention catheter shaft.
- Claim 17 recites an outer layer that may be 'a medicated coating,' a broad functional category that could be read to encompass an anti-thrombogenic (heparin) outer coating.
- Claim 15's list of inert substrate materials includes polymers structurally related to polyurethane (e.g., polyesters, polyolefins, polyisocyanates), so the general concept of coating a polymeric catheter substrate falls within the claimed genus of inert surfaces.
- Claim 18 (dependent on claim 1) contemplates 'covalent bonds between the bond coat layer and the surface of the device,' showing the patent family does contemplate covalent attachment as an option, which could create overlap with the invention's covalently bonded heparin layer if a bond-coat-like intermediate structure is present.

Appears to differ (AI reasoning):

- Claim 1 (and independent claims 23, 26, 27) require the inert surface to have 'no reactive functional groups' and require the bond coat to be bonded to that surface via NON-COVALENT bonds 'without the need for penetration into the inert surface.' The invention's core feature is heparin COVALENTLY bonded directly to the polyurethane surface, which appears to conflict with this non-covalent bonding requirement for the primary bond coat layer.
- The claims require a two-component architecture: (a) a distinct bond coat layer non-covalently attached to the substrate, and (b) a separate outer layer adhered to that bond coat. The invention as described appears to use a single covalently-bonded heparin layer directly on the polyurethane shaft, without a described intermediate non-covalent bond coat, so the claimed layered structure does not clearly appear to be present.
- The claims are directed to abrasion resistance and water-soak adhesion performance metrics (resistance to bending, tape removal, soaking) as defining functional limitations; the invention's stated purpose (anti-thrombogenic reduction of thrombus formation) and its testing/functional claims are not described in these terms, so it is unclear the invention meets these specific claimed performance limitations.
- None of the claims recite or require a UV-curing fixation step; while this omission alone would not distinguish (added invention features can't avoid a claim), the invention's fixation approach appears bound up with the covalent-bond requirement above, reinforcing that the claimed non-covalent bond coat mechanism is structurally different from the invention's UV-cured covalent heparin attachment.
- Dependent claims 2-14, 19-22 add further specific limitations (e.g., thickness ranges, specific polymer chemistries, cross-linkers, pretreatment steps, heating-time limits) that are not addressed by the invention description and would need individual comparison if the independent claim's core non-covalent bonding limitation were found to overlap.

Note: Analysis is based solely on the verbatim claims of US6306176B1 as provided. The central claimed architecture (independent claims 1, 23, 26, 27) is built around a NON-COVALENT bond-coat layer applied to an inert surface lacking reactive functional groups, plus a separate outer layer. The invention's key feature—heparin COVALENTLY bonded directly to a polyurethane surface via dip-coating and UV curing—appears structurally different from this non-covalent bond-coat/outer-layer scheme, though claim 18's mention of an additional covalent bond option and the broad 'medicated coating' language in claim 17 create some potential overlap warranting a closer look, including consideration of claim equivalents. This is an informational screening note only, not a legal or infringement opinion; a full claim chart and attorney review would be needed for any FTO determination. ⚠ LEGAL STATUS (Google Patents):

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Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The UV-curing paragraph explicitly states 'this omission alone would not distinguish (added invention features can't avoid a claim)' but then still uses it to 'reinforce' the distinguishing argument, which is a wrong-direction/inconsistent use of a non-limiting claim feature to support distinguishing conclusion.
- The claim 15 overlap statement characterizes polyesters, polyolefins, and polyisocyanates as 'polymers structurally related to polyurethane,' which is an overstated chemical characterization not supported by the patent text (polyisocyanates are precursors/monomers, not equivalent to polyurethane, and the patent does not state this relation).
- The claim 17 'medicated coating' overlap point speculates that this broad term 'could be read to encompass' an anti-thrombogenic heparin coating, which is a reasonable but speculative inference not explicitly supported by the abstract/claims (heparin or anti-thrombogenic agents are never mentioned in the patent text).

3.13 US10016532B2 — Non-fouling, anti-microbial, anti-thrombogenic graft compositions

Assignee: Teleflex Life Sciences Ltd · Published: 2018-07-10 · Status: Expired - Fee Related · exp. 2031-09-07 · Relevance: MEDIUM · verify on Google Patents ↗

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Potential overlap (AI reasoning):

- Claim 3 recites UV as one of the free radical initiators usable in the grafting process, which is broad enough that the invention's UV curing step to fix covalent bonds could fall within this generic category of UV-initiated chemistry, raising an equivalents-type overlap concern.
- Claim 12 broadly recites formation of covalent bonds between (a) the grafted polymer and the primer, or (b) the primer and the substrate — this is a generic covalent-bonding limitation that could be read broadly enough to encompass the invention's covalent heparin-to-polyurethane bonding, depending on how 'substrate' and 'primer' are construed.
- Both are directed to anti-thrombogenic/non-fouling coatings on medical device surfaces intended to reduce adhesion of biological material (fibrinogen/thrombus), which is the same general functional purpose.

Appears to differ (AI reasoning):

- Claim 1 (the base claim from which nearly all others depend) requires depositing a distinct 'polymeric primer' layer of at least 50 nm thickness with at least 5 nanomolar equivalents/cm2 of a functional group, and then grafting a separate polymer from that primer — the invention as described appears to be a direct dip-coating of heparin onto a polyurethane surface with no described intermediate primer layer of this type, so this structural limitation appears unmet.
- Claim 1 further requires the primer + grafted polymer combination to achieve a specific quantitative fibrinogen adsorption performance (<~75 ng/cm2 in a defined radiolabeled assay) — no such performance limitation is described for the invention's heparin coating.
- Claim 2 requires the graft to be formed 'by exposing the functional group to a free radical initiator and a monomer or monomer mixture' — the invention describes UV curing to fix covalent bonds between heparin and polyurethane, not a free-radical graft polymerization of a monomer from a primer layer, so this mechanism appears absent.
- Claims 14/19/20 require specific zwitterionic (sulfobetaine/carboxybetaine) or LMA/HPMA/TMOSMA/SBMA copolymer compositions for the primer or grafted polymer — the invention uses heparin, not these polymer chemistries, so these narrower claims appear inapplicable.

- Claim 5/23/24 require specific reactive functional groups (glycidyl, isocyanate, amine, benzophenone, etc.) on the primer for substrate attachment — the invention's covalent heparin-polyurethane bonding chemistry is not described with reference to these particular functional groups, leaving alignment unclear/unmet.

Note: This patent claims a multi-step process requiring deposition of a separate polymeric primer layer (with defined thickness/functional-group density) followed by graft polymerization of a polymer from that primer, yielding a surface meeting a specific fibrinogen-adsorption performance threshold. The invention as described is a simpler direct dip-coating of heparin covalently bonded to a polyurethane catheter surface with UV curing, lacking the described primer-plus-graft architecture. There is a generic-level potential overlap around UV-based initiation and covalent-bond formation language, and both target anti-thrombogenic/non-fouling performance, but the core structural process limitations of claim 1 (which most dependent claims rely on) do not clearly appear to be met based on the invention description provided. This is an informational screening observation only, not a legal infringement or freedom-to-operate conclusion, and would benefit from closer claim construction and a fuller technical description of the invention's coating architecture. ⚠ LEGAL STATUS (Google Patents): Expired - Fee Related — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement about Claim 3's UV initiator is somewhat overstated: claim 3 depends on claim 2, which depends on claim 1, meaning UV initiation is claimed only in the specific context of grafting a polymer from a primer layer via free-radical exposure to a monomer — not as a generic UV-curing-to-fix-covalent-bonds concept as the invention uses it. Framing this as a raw 'equivalents-type overlap' understates that the dependent claim is narrowed by the primer/monomer architecture from claim 1.
- Similarly, the Claim 12 overlap statement treats the covalent-bonding language as freestanding, but claim 12 depends on claim 1 and is limited to covalent bonds specifically between the grafted polymer/primer or primer/substrate within that defined primer-and-graft process — describing this as generically encompassing 'the invention's covalent heparin-to-polyurethane bonding' without that structural context is an overstatement.
- The distinguishing points reasoning is directionally correct in noting claim 1's primer/graft architecture and fibrinogen threshold are not met by the invention description, which is proper (narrower limitations not met can support non-infringement), so no wrong-direction FTO logic is present overall; however, the note's own overlap section undercuts its own distinguishing section by inflating dependent-claim breadth beyond what claim 1's incorporated limitations actually allow.

3.14 US20230099559A1 — Medical devices

Assignee: MicroVention Inc · Published: 2023-03-30 · Status: Pending · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 broadly requires an outer surface coupled to a polymer, and claim 6 requires that polymer be covalently coupled to the outer surface, which as a generic concept of a covalently attached surface coating could overlap with the invention's covalently bonded heparin coating on the polyurethane surface, subject to equivalents analysis
- Claim 2 recites an expandable tubular body configured for implantation into a blood vessel, which is a broader device category that could read on catheter-adjacent coronary intervention devices depending on construction

Appears to differ (AI reasoning):

- Claim 1 specifically requires the coupled polymer be prepared from free radical polymerization of a first acrylate-type monomer (alkoxyalkyl (meth)acrylate, tetrahydrofurfuryl acrylate, or alkoxyalkyl acrylate) and a second monomer bearing an amine, carboxylic acid, or hydroxyl functionality; the invention's heparin coating is not described as such an acrylate copolymer, so this required chemical composition appears absent

- Claims 11-31 require the outer surface be silanized or hydroxylated as a precursor to polymer attachment; the invention describes a polyurethane surface layer with heparin covalently bonded, with no mention of silanization or hydroxylation chemistry
- Claim 3 requires the expandable tubular body include a metal (with specific metal/alloy limitations in claims 4,5,9); the invention's catheter shaft substrate is described as polyurethane, not metal, so these metal-based dependent limitations appear unmet
- The claims are directed to an acrylate-monomer-derived polymer coating chemistry, not to heparin or an anti-thrombogenic heparin coating specifically; no claim recites heparin, dip-coating, or UV curing as steps or materials

Note: This patent's claims center on a specific free-radical-polymerized acrylate/amine-carboxylic-acid-hydroxyl copolymer coating chemistry, optionally applied via silanization or hydroxylation of the device surface, primarily for expandable tubular implants (e.g., stents), with metal substrate variants in dependent claims. The invention concerns a polyurethane catheter shaft with covalently bonded heparin applied by dip-coating and fixed via UV curing for anti-thrombogenic purposes. There is a generic conceptual overlap around 'covalently coupled polymer to an outer surface' (claim 1/6) and 'expandable tubular body for blood vessel implantation' (claim 2), but the claims' specific required monomer chemistry (acrylate + amine/carboxylic acid/hydroxyl monomer via free radical polymerization) and surface pretreatment (silanization/hydroxylation) do not appear to correspond to the invention's heparin-polyurethane covalent bonding chemistry or its UV-curing/dip-coating process. No claim mentions heparin or anti-thrombogenic coatings specifically. Relevance is assessed as low given the divergent underlying chemistry, though the covalent-coupling language in claims 1 and 6 warrants a cautious equivalents note. This is an informational screening observation only, not a legal or infringement conclusion. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing point citing claims 3,4,5,9 (metal substrate limitations) is misleading direction-wise: claim 1 itself does not require a metal, so the absence of metal in the invention does not distinguish from claim 1's broader scope; relying on dependent claim limitations not present in claim 1 to argue non-overlap is a wrong-direction FTO argument since the broadest claim 1 lacks that limitation and is more relevant to freedom-to-operate risk.
- Similarly, citing claims 11-31 (silanization/hydroxylation) as distinguishing is only valid against those dependent claims, not against independent claim 1, which does not require silanization/hydroxylation; the note's framing could overstate the distinguishing effect by implying the whole claim set requires this, when claim 1 is broader and does not.
- The statement 'no claim recites heparin, dip-coating, or UV curing as steps or materials' is accurate but used as a distinguishing point in a way that could be seen as reasoning from absence of narrowing limitations in claim 1 (which is broad) as if it protects against infringement — the note does appropriately flag claim 1's broad language as overlap, but then downplays it via the specific monomer chemistry requirement, which is legitimate since claim 1 does specify the monomer chemistry as a limiting element (this part is faithful, not fabricated).

3.15 US20250186758A1 — Circulatory support device with drug eluting coating

Assignee: Boston Scientific Scimed Inc · Published: 2025-06-12 · Status: Pending · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Independent claims 16 and 20 recite a 'drug eluting coating' comprising an excipient and a generically-termed 'anticoagulant' (not limited to DOAC) — this broader anticoagulant language could be read to encompass a heparin-based coating, creating potential overlap with the invention's anti-thrombogenic heparin coating purpose.
- Both the patent and the invention involve applying an anticoagulant-functionalized coating to a polyurethane-containing surface of a catheter-associated device to reduce thrombus/clotting risk, which is a shared functional concept.

- Claim 3 recites the excipient may be 'thermoplastic polyurethane,' overlapping generically with the invention's polyurethane surface layer material, though used in a different coating architecture (excipient/drug matrix vs. covalent surface bonding).

Appears to differ (AI reasoning):

- Independent claim 1 (and all dependent claims, including 16/20) requires a 'percutaneous blood pump' with a flexible cannula, impeller housing, and motor housing coupled to an elongate shaft, configured to pump blood through the housing — the invention is described only as a coronary catheter shaft with no blood pump, impeller, or motor housing, which appears to be a required structural element the invention lacks.
- All independent claims require the coating to be a 'drug eluting coating,' i.e., a coating designed to release/elute a therapeutic agent over time from an excipient matrix; the invention describes heparin covalently bonded to the polyurethane surface (a fixed, non-eluting immobilization), which appears inconsistent with the claims' elution-based mechanism.
- Claims 2, 4, 5, 8, and 14 specifically require a 'direct oral anticoagulant (DOAC)' such as apixaban, rivaroxaban, or edoxaban as the therapeutic agent — heparin is not a DOAC, so these narrower claims appear not to be met by the invention's heparin coating.
- Claims 4, 5, and 18 require specific excipient/drug weight-percentage ranges for a drug-in-matrix coating; the invention's covalent bonding process (dip-coating plus UV curing to fix covalent bonds) does not describe an excipient-based weight-percent drug loading, so this limitation appears unaddressed by the invention as described.
- Claims 10-13 require the coating be positioned relative to a slotted hypotube/polyurethane sheath cannula structure of a blood pump — structures not present in the described catheter shaft invention.

Note: This is an informational screening comparison only, not a legal or infringement/FTO conclusion. The patent's claims are all directed to a 'percutaneous circulatory support device' incorporating a blood pump (flexible cannula, impeller housing, motor housing) with a drug-eluting coating containing an excipient and an anticoagulant (DOAC in most claims, broader 'anticoagulant' in claims 16/20). The invention as described is a coronary catheter shaft with heparin covalently bonded (not eluted) to a polyurethane surface via dip-coating and UV curing. The core device architecture (blood pump with impeller/motor housing) required by every claim appears absent from the invention, and the coating mechanism (covalent immobilization vs. drug elution from an excipient) appears fundamentally different, which are significant distinguishing considerations. The broader anticoagulant language in claims 16/20 nonetheless warrants attention as a potential overlap area, particularly if the underlying device were ever combined with pump functionality. Full claim charting and expert legal review would be needed for a definitive assessment. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

3.16 US6372283B1 — Plasma process for surface modification of pyrolitic carbon

Assignee: Medtronic Inc · Published: 2002-04-16 · Status: Expired - Fee Related · exp. 2019-04-02 · Relevance: LOW · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Fee Related (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Both relate generally to modifying a substrate surface to add a polymer and/or bio-active (e.g., antithrombotic) compound for medical device applications, which is a broad thematic overlap with the invention's anti-thrombogenic coating purpose

Appears to differ (AI reasoning):

- All independent claims (1, 9, 13) require a pyrolytic carbon surface as the substrate being modified; the invention's substrate is a polyurethane-surfaced catheter shaft, not pyrolytic carbon, so this foundational element appears absent

- The claims require depositing an oxygen-containing, silicon-containing siloxane film forming monomer via plasma deposition, which the invention does not appear to use (invention uses dip-coating, not plasma deposition of a siloxane)
- The claims require priming the siloxane-coated surface with a silane compound prior to adding polymer/bio-active compound; the invention has no silane priming step described
- The claims are directed to a method of surface modification via plasma/siloxane/silane chemistry, whereas the invention uses covalent bonding of heparin via UV curing, a different chemical fixation mechanism not required or suggested by these claims
- Claim 13 is specific to prosthetic heart valves, not coronary intervention catheter shafts, though this is a device-type difference rather than a strict claim limitation issue in claims 1 and 9 which are broader

Note: This patent's claims are centered on a specific plasma-deposition/siloxane/silane surface-modification process for pyrolytic carbon substrates to improve polymer adhesion, optionally followed by addition of a polymer (e.g., polyurethane) and/or bio-active compound (e.g., antithrombotic agent). The invention's polyurethane catheter shaft with covalently bonded heparin applied via dip-coating and UV curing does not appear to involve a pyrolytic carbon substrate, plasma-deposited siloxane film, or silane priming step, which are required elements in every independent claim. While there is thematic overlap in the general goal of attaching bio-active/antithrombotic compounds to a polymer-coated medical device surface, the specific claimed process steps and substrate material appear to differ substantially from the invention as described. This is an informational screening note only, not a legal or infringement opinion. ⚠ LEGAL STATUS (Google Patents): Expired - Fee Related — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

3.17 US6306165B1 — ePTFE small caliber vascular grafts with significant patency enhancement via a surface coating which contains covalently bonded heparin

Assignee: Boston Scientific Scimed Inc, Lifeshield Sciences LLC · Published: 2001-10-23 · Status: Expired - Lifetime · exp. 2016-09-13 · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Lifetime (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1 broadly covers an implantable medical device with a hydrophobic surface bearing a covalently bound bio-active coating (including antithrombogenic agents such as heparin) — this generic framing could encompass a polyurethane catheter shaft (hydrophobic surface) with covalently bonded heparin, which is an antithrombogenic agent.
- Claim 3 recites a medical device with a body fluid contacting surface covalently bonded to a bio-active coating comprising a polymeric structure with a pendant antithrombogenic agent — this broad language could read on a catheter shaft surface with covalently bonded heparin used for anti-thrombogenic purposes.
- The claims' antithrombogenic-agent limitation is broad enough to potentially encompass heparin as used in the invention, since heparin is a well-known antithrombogenic agent.

Appears to differ (AI reasoning):

- Claims 1, 3, and 4 require a specific linkage architecture: a polymer backbone bound via an amide or amine linkage to a hydrophilic, amine-terminated spacer, which is itself covalently bound to the bio-active molecule at its second end, with the spacer selected from an enumerated list (oxygenated polyolefins, aliphatic polyesters, polyamino acids, polyamines, hydrophilic polysiloxanes/polysilazanes, hydrophilic acrylates/methacrylates, linear or lightly branched polysaccharides) — the invention as described does not specify any such spacer/linker chemistry, only a direct covalent bond between heparin and the polyurethane surface.

- Claim 2 requires the device to be a tubular ePTFE vascular graft with a diameter of 5 mm or less — the invention is a coronary catheter shaft with a polyurethane surface, not an ePTFE graft, so this specific claim appears inapplicable.
- Claim 4 requires a hydrophobic substrate with plasma-induced hydrophilic functionality as part of the surface modification — the invention describes UV curing and dip-coating, not plasma-induced functionalization, so this specific claim limitation appears unmet.

Note: This informational screening compares the invention against the verbatim claims of US6306165B1. The patent's broadest claims (1, 3) are drafted in terms of a hydrophobic surface bearing a covalently bonded bio-active coating with an antithrombogenic agent, which could generically overlap with the invention's covalently bonded heparin on a polyurethane (hydrophobic) surface. However, all three independent claims require a specific molecular architecture (a polymer backbone linked via amide/amine bond to a hydrophilic amine-terminated spacer selected from an enumerated chemical class, itself covalently bound to the bio-active agent) that is not described in the invention summary, which mentions only direct covalent bonding of heparin to polyurethane via dip-coating and UV curing. This spacer/linkage limitation is a significant potential distinguishing feature, though claim scope and equivalents analysis would require review of the full specification (including the referenced chemical structures/R-groups omitted from this claim text) and expert legal review. This is not a legal or infringement conclusion. ⚠ LEGAL STATUS (Google Patents): Expired - Lifetime — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statements slightly overstate the claims' breadth by omitting the mandatory spacer/linkage architecture when describing claims 1 and 3 as broadly covering 'a covalently bound bio-active coating' — the claims actually require the specific amide/amine-linked spacer structure, which the overlap section does not mention until the distinguishing section; this creates a partial mismatch between how the overlap and distinguishing sections characterize the same claims.
- The distinguishing point about the spacer/linker chemistry not being specified in the invention is valid as a difference, but the note frames the invention's lack of a specified spacer as a distinguishing feature without adequately weighing that claim 1's introductory clause ('at least one hydrophobic surface... bio-active coating bound thereto') is broad — this is a legitimate distinguishing argument based on an actual claim limitation (the spacer element is affirmatively required), so it is not wrong-direction reasoning, but the note should be clearer that this is a required element in the claim, not merely an absent feature in the invention.
- The final synthesis paragraph accurately reflects the claims text and is appropriately hedged with disclaimers about incomplete R-group structures and need for legal review, which is faithful to the evidence.

3.18 US20120148852A1 — Silane coating compositions, coating systems, and methods

Assignee: Surmodics Coatings LLC · Published: 2012-06-14 · Status: Abandoned · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Abandoned (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 18 recites a method of applying actinic energy (e.g., UV) to a photoreactive group to form a polymer chain terminally/covalently anchored to a substrate-associated layer — this broadly overlaps with the invention's UV curing step used to fix covalent bonds between heparin and the polyurethane surface.
- Claims 5, 7, and 17 broadly claim covalent bonding between a polymer/coating layer and an underlying base layer/substrate, which could read on the invention's covalently bonded heparin-to-polyurethane surface layer.

- Claim 1/14's general architecture of a substrate with a coating layer applied via a solution-based process (dip-coating analog) and cured/fixed onto the surface overlaps generically with the invention's dip-coating and UV-fixation approach.
- Claim 4's 'biocompatible moiety' and claim 2's 'hydrophilic moiety' are broad functional descriptors that could encompass heparin as a biocompatible/hydrophilic anti-thrombogenic moiety, depending on claim construction.

Appears to differ (AI reasoning):

- Claims 1, 14, and 18 require a base/first layer specifically comprising a silane compound (or other compound) with a photoreactive group (e.g., azides, diazos, benzophenone per claims 9-12) interposed between the substrate and the polymer layer; the invention as described does not mention any silane-based photoreactive intermediate layer, instead describing direct heparin functionalization and UV curing on the polyurethane surface itself, which appears to lack this specific required intermediate chemistry.
- Claim 18 requires forming a 'polymer chain from the monomer' via in-situ polymerization initiated by actinic energy on the photoreactive silane; the invention describes covalently bonding pre-existing heparin molecules (not monomer polymerization to build a new anchored polymer chain), which is a different mechanism from what the claim requires.

Note: This is an informational screening note, not a legal opinion. The patent's claims center on a specific two-layer architecture using a silane (or other) photoreactive base layer to terminally anchor a polymer layer via UV-induced polymerization. The invention's UV-cured covalent heparin-polyurethane bonding shows conceptual overlap (UV/actinic curing to fix covalent bonds on a substrate coating), but the claims' explicit requirement of a silane/photoreactive intermediate layer and monomer-based polymer chain formation are not clearly present in the invention's described heparin dip-coating process. Equivalents analysis (e.g., whether heparin-functionalized solutions include analogous photoreactive linker chemistry) would require more technical detail on the invention's actual chemistry to resolve fully. ⚠ LEGAL STATUS (Google Patents): Abandoned — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap claim regarding claims 5, 7, and 17 is overstated: these claims require covalent bonding specifically in the context of the claimed silane/photoreactive base layer architecture (dependent on claim 1 or 14), not a generic 'polymer/coating layer to substrate' bond as implied; presenting them as broadly reading on the invention's heparin-polyurethane bond without the required base layer is an overstatement.
- The overlap claim for claim 1/14's 'general architecture' being a 'dip-coating analog' is fabricated/overstated — the claims do not mention or imply any dip-coating or solution-based application method; this is an invented analogy not supported by the claim text.
- The suggestion that claims 2 and 4's 'hydrophilic moiety' and 'biocompatible moiety' 'could encompass heparin' is speculative construction not directly supported by the patent text, though flagged appropriately as depending on claim construction — borderline acceptable but should be treated with more skepticism than presented.
- The distinguishing point about the absence of a silane/photoreactive intermediate layer in the invention is reasoning in the correct direction (narrower claim requirement not met by invention reduces overlap), which is appropriate, but the note frames this as reducing risk without acknowledging that this narrowing actually strengthens the distinguishing argument only if claim 1 is the broadest asserted claim — this is fine, no wrong-direction issue here.
- The distinguishing point about claim 18 requiring 'monomer' polymerization versus the invention's use of 'pre-existing heparin molecules' is reasonable but slightly overstated in certainty ('a different mechanism from what the claim requires') given the note itself later hedges that more technical detail is needed.

3.19 US20080215138A1 — Coated implantable medical device

Assignee: Cook Medical Technologies LLC · Published: 2008-09-04 · Status: Expired - Fee Related · exp. 2019-01-06 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both concern coated implantable vascular devices with a bioactive/functional agent posited over a device surface, which is broadly analogous to the invention's coated catheter shaft concept
- Claim 8 lists polyurethane as an acceptable base material for the structure, overlapping generically with the invention's polyurethane surface layer

Appears to differ (AI reasoning):

- All independent claims require 'at least one layer of an immunosuppressive agent' (e.g., cyclosporin) as the active bioactive layer; the invention uses heparin for anti-thrombogenic purposes, not an immunosuppressive agent, so this required element appears absent
- Claims require 'at least one porous layer posited over' the immunosuppressive agent layer, typically applied by vapor or plasma deposition per the specification; the invention's dip-coating and UV-curing process for covalent heparin bonding does not appear to include this porous overlayer element
- Claims 1/12/19-21 require the structure be a stent (or generic implantable structure) with controlled-release coating architecture (coating layer + immunosuppressive layer + porous layer); the invention is a catheter shaft with a single covalently bonded heparin coating layer, lacking the multi-layer controlled-release architecture required by these claims
- Dependent claims requiring wells/grooves/holes or specific coating thickness ranges (50,000-500,000 Angstroms) are structural limitations not evidenced in the invention description

Note: This patent's claims are directed to a multi-layer controlled-release drug-delivery architecture for immunosuppressive agents (e.g., cyclosporin) on implantable devices/stents, using a coating layer plus a porous overlayer. The invention is a coronary catheter shaft with a covalently bonded heparin coating via dip-coating and UV curing for anti-thrombogenic purposes. While both fields involve coated vascular devices and the patent's material list generically includes polyurethane, the claims' core required elements (immunosuppressive agent, porous overlayer, controlled-release multi-layer structure) do not appear to be present in the invention as described. Relevance is assessed as low given the divergent therapeutic agent, coating chemistry (covalent bonding vs. adsorption/absorption), and layer architecture. This is an informational screening note only, not a legal or infringement opinion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement 'Both concern coated implantable vascular devices with a bioactive/functional agent posited over a device surface, which is broadly analogous to the invention's coated catheter shaft concept' is a fair generic characterization, but calling it 'overlap' is a stretch since the invention is a catheter shaft (delivery device) not a stent/implantable structure per the patent's primary claim scope; this is an imprecise framing rather than fabrication.
- The claim 8 material list does include polyurethane as a listed base material option, so that specific overlap claim is supported.
- The distinguishing point 'invention is a catheter shaft ... lacking the multi-layer controlled-release architecture required by these claims' is valid distinguishing reasoning based on claim language.
- The statement that dependent claims on wells/grooves/thickness 'are structural limitations not evidenced in the invention description' is technically true but reasoning from absence in dependent (narrower) claims is not concerning since these are narrowing limitations, not the broadest claim scope — this is fine directionally, but the note should be careful that the key distinguishing analysis rests on the broadest independent claims (1, 12, 19-21), which it does correctly by noting the immunosuppressive agent and porous layer requirements are absent from the invention, which is proper FTO direction logic (claim requires elements invention lacks = no literal infringement), so no wrong-direction reasoning found on the core distinguishing points.

3.20 US20210378678A1 — Non-thrombogenic devices for treating edema

Assignee: White Swell Medical Ltd · Published: 2021-12-09 · Status: Pending · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both relate to non-thrombogenic/anti-thrombogenic surface treatments on intravascular catheter-based devices intended to reduce thrombus formation, which is a shared general functional purpose (claim 1, 31).

Appears to differ (AI reasoning):

- Claim 1 requires a cage attached to the distal portion of the catheter that houses an impeller, with the non-thrombogenic interface on the cage or impeller surface — the invention as described has no cage/impeller structure, so this core structural limitation appears absent.
- Claim 1 and dependents (2-7, 12, 15-22, 29) require the non-thrombogenic interface to be a 'metallic interface' (transition metal, alloy, or metal oxide film such as TiO2/Cr2O3/Al2O3) — the invention's coating is a polyurethane surface with covalently bonded heparin, which is a polymer/biomolecule chemistry, not a metallic or metal-oxide interface, so these metallurgical limitations appear unmet.
- Claim 25/45 requires hydrophilic groups (e.g., a triol) attached to an oxide film specifically; the invention's heparin is bonded to polyurethane, not to a metal oxide film, so this specific attachment limitation appears distinguishable.
- Claim 42 requires an atraumatic tip extending from the cage — inapplicable given the invention lacks a cage.

Note: This patent's claims are directed to a specific intravascular impeller/cage device with a non-thrombogenic METALLIC surface (metal, alloy, or oxide film), whereas the invention is a coronary catheter shaft with a polymer (polyurethane) surface bearing covalently bonded heparin applied via dip-coating and UV curing. The claims' central structural requirement (cage housing an impeller) and material requirement (metallic/oxide interface) do not appear to be present in the invention. Overlap is limited to the general anti-thrombogenic functional goal, which alone is unlikely to be the operative claim scope. This assessment is based solely on the verbatim claims provided; no legal conclusion on freedom to operate is intended. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

3.21 US7807750B2 — Thermally-reactive polymers

Assignee: Surmodics Coatings LLC · Published: 2010-10-05 · Status: Expired - Lifetime · exp. 2025-04-15 · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Lifetime (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 7 recites a polyurethane backbone for the coated polymer, which overlaps with the invention's polyurethane surface layer as a coating substrate
- Claim 29 recites the coated article may be a catheter, overlapping with the invention's coronary catheter application
- Claim 17 recites that the polymer becomes covalently bonded to the surface, which is conceptually similar to the invention's covalently bonded heparin coating (though via a different chemical mechanism)
- Claims 28/32 recite coating of an inner surface of the article, which could overlap with catheter shaft coating scenarios
- The general purpose of improved surface passivity/anti-thrombogenic-type performance in the abstract is broadly similar to the invention's anti-thrombogenic goal, though the patent's stated bio-effect is passivity/anti-microbial rather than explicitly anti-thrombus

Appears to differ (AI reasoning):

- Claim 1 (and all independent claims 30-32) require a thermally-reactive polymer that undergoes homolytic cleavage upon HEATING to generate a polymer-coupled radical species that then covalently bonds to a target moiety; the invention instead uses UV curing to fix heparin-

polyurethane covalent bonds, which is a different activation chemistry (photochemical vs. thermal radical generation) not clearly present in the invention

- Claims 2-5, 33-34, 37-41 further require specific thermally-reactive groups (peroxide, peroxyester, alkyldioxyl, alkoxy radicals, nucleophilic iodo-amine coupling chemistry) that are heat-activated; the invention's UV-cured heparin bonding does not appear to rely on this radical-based thermal chemistry
- The claims are directed to a method of forming a coating via a specific radical-generating polymer chemistry, not to a heparin-specific anticoagulant coating; heparin as the bonded moiety is not recited, so the specific chemistry linking heparin to polyurethane via UV curing is not addressed by the claims
- No claim recites dip-coating as an application step; while this is not itself a differentiator under the overlap rules (broader claims could still cover it), the core distinguishing issue is the heat-vs-UV curing mechanism required by the independent claims

Note: This patent's claims are method claims centered on a thermally-reactive polymer chemistry (heat-induced homolytic cleavage of a peroxide/peroxyester-type pendent group to form covalent bonds), which is mechanistically different from the invention's UV-curing-based approach to fixing heparin-polyurethane covalent bonds. There is potential overlap in the general subject matter (polyurethane-based coatings, catheter application, covalent surface bonding, inner-surface coating), which warrants review, but the central curing/activation mechanism required by the independent claims (thermal radical generation) appears to differ from the invention's UV-based fixation step. This is an informational screening note, not a legal or infringement conclusion; a full claim-construction and equivalents analysis would be needed for a definitive assessment. ⚠ LEGAL STATUS (Google Patents): Expired - Lifetime — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement citing the abstract's 'passivity/anti-microbial activity' as 'broadly similar' to the invention's anti-thrombogenic goal is a stretch; the abstract does not mention thrombus or anticoagulant effects, so equating passivity/anti-microbial with anti-thrombogenic overstates similarity, though the note does hedge this appropriately.
- The distinguishing point regarding heparin not being recited in the claims ('heparin as the bonded moiety is not recited, so the specific chemistry linking heparin to polyurethane via UV curing is not addressed by the claims') is wrong-direction FTO reasoning: claim 1 is broad and generic to 'a target moiety' without excluding heparin, so the absence of heparin-specific language in the claims does not distinguish or narrow the claim - broad claims covering any target moiety are more likely to read onto a heparin embodiment, not less. This reasoning improperly treats claim breadth as a distinguishing/safe factor.
- The note's repeated emphasis that lack of recitation of dip-coating or heparin somehow supports distinguishing, despite momentarily acknowledging the correct rule for dip-coating, is inconsistent when applied to heparin - the note should have flagged the heparin point the same way it flagged the dip-coating point, but instead treats it as a distinguishing factor.

3.22 US20130123664A1 — Medical device having a lubricious coating with a hydrophilic compound in an interlocking network

Assignee: Abbott Cardiovascular Systems Inc · Published: 2013-05-16 · Status: Abandoned · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Abandoned (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1/31 broadly covers a cured coating applied to a medical device via a solution mixture, which as a generic coating/curing process could overlap with the invention's dip-coating and curing of a heparin-functionalized solution onto the catheter shaft.

- Claims 3, 33, and 41 recite curing the coating using an ultraviolet (UV) source, which corresponds to the invention's UV curing step used to fix the heparin-polyurethane bonds.
- Claim 19 and 40 cover a balloon/guide catheter having an elongated catheter shaft with the lubricious coating applied to the shaft, overlapping generically with the invention's coronary catheter shaft substrate being coated.

Appears to differ (AI reasoning):

- Claim 1 (and claim 31) requires a solution mixture with a multifunctional monomer/polymer network-forming compound plus distinct short-chain and long-chain hydrophilic compounds, cross-linked via two different (first and second) cross-linkers to form an interlocked dual-network structure; the invention as described is a single heparin coating covalently bonded to a polyurethane surface, with no indication of a separate multifunctional monomer/polymer network, no short/long chain hydrophilic compound pair, and no dual (first/second) cross-linker system.
- Claim 10 requires (in that embodiment) that the hydrophilic compound network is NOT chemically/covalently bonded to the polymer network, which is a structurally different bonding scheme than the invention's explicit covalent bonding of heparin to the polyurethane surface — though this is only one dependent embodiment, other claims (1, 31) still require the interlocked-network architecture the invention does not describe.
- Claims 7-9 require polyvinylpyrrolidone (PVP)-based short/long chain hydrophilic compounds as the lubricity-providing agents; the invention's functional agent is heparin for anti-thrombogenic purposes, not a PVP-based lubricity compound, so this specific compound limitation is not met.
- Claims 28-30 describe a therapeutic agent that is releasably contained/elutes from the coating; the invention's heparin is covalently bonded (fixed, not eluting), which appears to differ from this releasable-agent limitation where such dependent claims are asserted.
- The independent claims are directed to a lubricity-focused coating (interlocked hydrophilic/monomer networks) rather than an anti-thrombogenic covalently-bonded bioactive coating, suggesting a difference in overall claimed structure and purpose from the invention's heparin-functionalized coating.

Note: This is an informational screening comparison only, not a legal or infringement opinion. The patent's independent claims (1 and 31) are grounded in a specific multi-component, dual cross-linker interlocked-network coating chemistry aimed at lubricity, which is broader/different in structure from the invention's simpler heparin-to-polyurethane covalent bonding aimed at reducing thrombus formation. Overlap exists at the level of generic process steps (solution-based coating application, UV curing, use on catheter shafts), which are broadly drafted and could be read to encompass the invention's process steps under a broad claim construction — this is flagged as potential overlap per the direction rules. However, the composition-specific limitations (monomer/polymer network former, short/long chain hydrophilic compounds, dual cross-linker system, PVP compounds, non-covalent hydrophilic network in claim 10) do not appear to be present in the invention's description, which specifically covalently attaches heparin. Full claims text was provided and reviewed verbatim; no claims were unreadable or missing. ⚠ LEGAL STATUS (Google Patents): Abandoned — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap claim regarding Claims 1/31 broadly covering a cured coating from a solution mixture overstates similarity, since claim 1/31 specifically require a multifunctional monomer/polymer network plus short/long chain hydrophilic compounds and dual cross-linkers — the note's own distinguishing section acknowledges this specificity, creating some internal tension, though it is flagged appropriately as 'generic process steps' overlap.
- The claim 10 discussion is essentially correct but the note's phrasing that non-covalent bonding in claim 10 is 'structurally different' while simultaneously conceding claim 10 is 'only one dependent embodiment' and that independent claims 1/31 still require the interlocked network is fine, but framing claim 10 as a meaningful distinguishing point is weak since it is a narrow dependent claim, not a distinguishing feature of the independent claims themselves — minor overstatement of relevance.

- The statement that claims 7-9 requiring PVP compounds means 'this specific compound limitation is not met' is a distinguishing argument based on the dependent claims being narrower than the invention, which is fine, but citing narrow dependent claims (7-9, 28-30) as meaningful distinguishing points while the broader independent claims 1/31 are the actual risk is somewhat misleading about which claims matter most for FTO purposes — minor imprecision in emphasis, though the note does correctly caveat this by noting independent claims are the primary comparison.

3.23 US6309660B1 — Universal biocompatible coating platform for medical devices

Assignee: Edwards Lifesciences Corp · Published: 2001-10-30 · Status: Expired - Lifetime · exp. 2019-07-28 · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Lifetime (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1 (and dependent claims 2, 5, 18) broadly covers use of heparin/heparin salts as the water-soluble biocompatible polymer or bioactive agent in an anti-thrombogenic coating platform for medical devices — this generic category could encompass the invention's use of heparin as the active anti-thrombogenic agent.
- Claims 13 and 23 claim 'a medical device' provided with the coating platform — broad enough in category to potentially read on a coronary catheter shaft bearing a heparin-based coating, since the claim does not limit device type.
- The patent's stated purpose (anti-thrombogenic coatings for devices contacting physiological fluids) aligns with the invention's anti-thrombogenic functional purpose, raising overlap at the level of intended use/function.
- Claim 12/21's list of 'antithrombogenic agents' as an optional bioactive compound is broad enough to potentially cover heparin as used in the invention.

Appears to differ (AI reasoning):

- Claim 1 requires a specific two-part architecture: (a) a molecular film formed by ionic binding of a first water-soluble polymer to a second water-soluble polymer, plus (b) a separate crosslinked interpenetrating network (IPN) formed from at least one multi-functional biocompatible polymer and at least one crosslinking agent covering that molecular film. The invention as described appears to use a single-step direct covalent bonding of heparin to a polyurethane surface, without a described ionic polyelectrolyte molecular film or a distinct crosslinked IPN layer — these structural elements required by claim 1 do not appear to be present.
- Claim 14's method requires three distinct steps: applying a first water-soluble polymer, applying a second water-soluble polymer, and applying a mixture of a multi-functional polymer plus a crosslinking agent. The invention's disclosed method (dip-coating in a heparin-functionalized solution followed by UV curing) does not appear to include this multi-step ionic-layer-plus-separate-crosslinking-agent process; UV curing as the bond-fixing mechanism is not recited in claim 14, which instead relies on a crosslinking agent (epoxide/isocyanate/aldehyde/carbodiimide) chemistry.
- Dependent claims 7-11 and 20 require crosslinking agents from specific chemical classes (epoxides, isocyanates, aldehydes, carbodiimides) — the invention's UV-curing-based covalent fixation does not correspond to use of any such chemical crosslinking agent, suggesting the invention may fall outside this specific mechanism if claim 1's IPN/crosslinking-agent limitation is treated as required.
- Claim 1 requires the heparin (or analogous polymer) to be 'ionically bound' as part of a polyelectrolyte molecular film (or in claim 2, ionically bound to the IPN surface), whereas the invention explicitly uses covalent bonding of heparin to the polyurethane surface — a different bonding chemistry that does not match the ionic-binding limitation as claimed.

Note: This is an informational screening comparison only, not a legal or infringement opinion. The patent claims a specific multi-layer coating architecture (ionic polyelectrolyte molecular film complexed with a

separately crosslinked IPN) applied via ionic-layer deposition and chemical crosslinking-agent chemistry, generally aimed at anti-thrombogenic device coatings. The invention describes a single-step covalent heparin-to-polyurethane bonding process fixed by UV curing, via dip-coating, on a coronary catheter shaft. There is topical/functional overlap (heparin, anti-thrombogenic purpose, medical device application) that keeps relevance at least medium, but the specific structural and process limitations of independent claims 1 and 14 (ionic molecular film, separate crosslinked IPN, multi-functional polymer, chemical crosslinking agent) do not clearly appear in the invention as described, which instead relies on direct covalent bonding and UV curing — features not recited in the claims. A full-text and file-history review, and comparison against all claim limitations in context, would be needed for a definitive assessment. ⚠ LEGAL STATUS (Google Patents): Expired - Lifetime — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The third bullet under 'Distinguishing points' states 'UV curing as the bond-fixing mechanism is not recited in claim 14, which instead relies on a crosslinking agent...chemistry' — this is wrong-direction reasoning: the fact that claim 14 does not recite UV curing does not distinguish the invention, since the absence of a limitation makes the claim broader (and thus more likely to read on the invention), not narrower. This point improperly uses a missing limitation in the patent claim as a distinguishing factor.
- Similarly, the note's framing that dependent claims 7-11/20 require specific crosslinking agents and 'the invention's UV-curing-based covalent fixation does not correspond to use of any such chemical crosslinking agent' is only relevant if the dependent claims are asserted; independent claim 1 does not require which specific agent, so this is a comparison against narrower dependent claims, correctly caveated as conditional ('if claim 1's IPN/crosslinking-agent limitation is treated as required'), which is acceptable but borders on overstating distinction strength.
- The claim 12/21 bullet listing 'antithrombogenic agents' as overlapping is a reasonable but generic inference; heparin is explicitly listed in claims 2/5/18, so citing claim 12/21 as an additional independent overlap point is a minor redundancy/overstatement rather than fabrication.

3.24 US6340465B1 — Lubricious coatings for medical devices

Assignee: Baxter International Inc, Edwards Lifesciences Corp · Published: 2002-01-22 · Status: Expired - Lifetime · exp. 2019-04-12 · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Lifetime (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1 broadly recites a coating composition with a coupling agent and polyfunctional polymer that entraps a 'biocompatible agent,' which under claim 16's list includes anticoagulant-type/antithrombotic agents (heparin is a well-known antithrombotic biocompatible agent) - the invention's heparin-coated catheter could fall within this broad genus if heparin is physically entrapped via a crosslinked coupling-agent/polymer network on the polyurethane surface
- The claimed purpose of imparting 'antithrombotic properties' to a medical device surface (per abstract and claim 16 categories) overlaps with the invention's anti-thrombogenic functional purpose
- Claim 2 broadly covers a coupling agent chemically linking a polymer layer to a medical device surface, which could read on the invention's covalent attachment chemistry linking heparin-related layers to the polyurethane substrate, subject to equivalents analysis

Appears to differ (AI reasoning):

- Claim 1 requires a specific three-component system (coupling agent + polyfunctional polymer + biocompatible agent) forming a three-dimensional crosslinking network that 'physically entraps' the biocompatible agent; the invention as described uses direct covalent bonding of heparin to the polyurethane surface itself, not entrapment within a separate crosslinked polymer/coupling-agent lattice — this entrapment mechanism appears to be a required limitation the invention may lack

- Claim 1 requires a defined coupling agent-to-polyfunctional polymer ratio (10:1 to 0.1:1); no such distinct multi-component ratio is described in the invention's direct covalent heparin-to-polyurethane bonding approach
- Claims 5, 7-13 require specific coupling agent chemistries (epoxides, isocyanates, aldehydes, carbodiimides) as the crosslinking/coupling mechanism; the invention's UV-curing-based covalent fixation method is not described as using these specific coupling agent classes
- Claims 3, 4, 6 require the polyfunctional polymer have specific functionality counts, equivalent weight, or be selected from a defined list (polyethylenimine, PVA, polyacrylic acid, polyacrylamide); no such distinct polyfunctional polymer layer is described in the invention

Note: This patent claims a coating composition technology (a crosslinked coupling-agent/polyfunctional-polymer lattice that entraps a biocompatible agent), which is compositionally and mechanistically different from the invention's direct covalent bonding of heparin to a polyurethane surface via dip-coating and UV curing. There is topical overlap in the antithrombotic/heparin-coated-catheter application space (claim 16 lists relevant biocompatible agent categories broadly), but claim 1's core requirement of a three-component entrapment system with a specific coupling agent and polymer ratio appears structurally distinct from the invention's simpler direct-bonding approach. Relevance is rated medium because while the field (biocompatible/antithrombotic catheter coatings) is closely related, the specific chemical architecture required by claim 1 differs from the invention's disclosed mechanism. A full equivalents analysis would depend on whether the invention's covalent bonding process could be characterized as falling within the claimed entrapment/coupling-agent framework, which is not clear from the provided invention description. ⚠ LEGAL STATUS (Google Patents): Expired - Lifetime — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The claim 16 list does not mention 'anticoagulant' or 'heparin' explicitly; the note's parenthetical characterization that heparin is 'a well-known antithrombotic biocompatible agent' within claim 16's list is an inference not directly stated in the provided claim text (claim 16 lists categories like antibacterial, antimicrobial, etc., but no antithrombotic/anticoagulant category is explicitly listed, though abstract does mention 'antithrombotic properties')
- The overlap statement about Claim 2 'broadly covers a coupling agent chemically linking a polymer layer to a medical device surface, which could read on the invention's covalent attachment chemistry' is speculative framing but reasonably grounded in claim 2 text, so acceptable as hedged speculation
- The distinguishing points about claim 1's specific ratio, claims 5/7-13 specific coupling agent chemistries, and claims 3/4/6 specific polymer selection lists are technically accurate as claim recitations, but framing them as 'distinguishing' is reasoning in the correct direction only if the invention lacks these elements entirely (narrower claims via added limitations are less dangerous) — however, claim 1 itself is the broadest independent claim and the note appropriately identifies claim 1 as the main overlap risk, so the dependent-claim distinctions are not wrong-direction since they narrow rather than broaden scope
- The note's characterization that claim 1 requires entrapment 'not covalent bonding' is a fair reading of the claim text ('physically entrapping'), so this is faithful, not fabricated

3.25 US20240226395A1 — Coating for medical devices

Assignee: Smart Reactors Service Ltd · Published: 2024-07-11 · Status: Pending · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 requires a base layer comprising a protein plus a polymer layer with hemocompatible groups (sulfonic acid, sulfonamide, sulfamic acid, hydrogen sulfate, or conjugate base) — heparin, being a sulfated polysaccharide, contains sulfate/sulfamate-type groups that could arguably fall within these broad chemical genus definitions, creating a potential overlap concern depending on claim construction of 'hemocompatible group' and 'polymer'

- Claim 2's requirement that the polymer layer be 'conjugated to the base layer' is broad language that could read on a covalently bonded heparin-polyurethane arrangement if polyurethane were considered to include or be layered with a protein-like base

Appears to differ (AI reasoning):

- Claim 1 requires a base layer comprising a protein; the invention's substrate is described as a polyurethane surface layer, not a protein layer, so this base-layer limitation does not appear to be met absent further disclosure of a protein sublayer
- Claims 18-20 recite a manufacturing method of applying a hemocompatible-group polymer onto a protein base layer, and optionally coupling via a coupling agent; the invention's dip-coating into a heparin-functionalized solution followed by UV curing to fix covalent bonds is a materially different process not reciting a protein base layer or the specific coupling-agent step

Note: This patent's claims center on a coating architecture defined by (i) a protein-containing base layer and (ii) a polymer layer bearing specific sulfur/sulfate-based hemocompatible functional groups (sulfonic acid, sulfonamide, sulfamic acid, hydrogen sulfate or conjugate bases), applied via a stated method. The invention as described uses a polyurethane shaft with covalently bonded heparin via dip-coating and UV curing — there is no explicit protein base layer, and heparin's relevant functional groups (sulfate/sulfamate esters and carboxylate) may or may not fall within the claimed genus of 'hemocompatible groups,' which is an open equivalents question. Relevance is assessed as low-to-medium primarily due to the missing protein base layer, a core limitation of claim 1 and the independent method claim 18. This is an informational screening note only, not a legal or infringement conclusion; full claim construction and comparison of heparin's chemical structure to the Markush groups in claims 4-15 would be needed for a more definitive assessment. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note states claim 2's 'conjugated to the base layer' language 'could read on a covalently bonded heparin-polyurethane arrangement if polyurethane were considered to include or be layered with a protein-like base' — this is speculative stacking of two hypotheticals (polyurethane as protein-like base, plus conjugation reading on covalent bonding) not well supported by the claim text, which requires an actual protein base layer per claim 1; this pushes plausibility further than the evidence supports.
- The characterization of heparin as containing 'sulfate/sulfamate-type groups that could arguably fall within these broad chemical genus definitions' is a reasonable chemical inference (heparin is indeed a sulfated polysaccharide) but is somewhat speculative since the patent's Markush claims (4-15) specify particular repeating-unit formulas (A-1, B-1) tied to specific polymer backbones, not just any sulfated biomolecule; the note appropriately flags this as uncertain but slightly overstates the 'overlap concern' before acknowledging the caveat.
- The note's distinguishing point that claim 1 requires a protein base layer which the invention lacks is valid, but the note does not adequately weigh that claim 1 is the broadest independent claim and its scope (not the dependent Markush claims) governs FTO risk; this is correctly used as a distinguishing feature since it is a claim requirement absent from the invention, not a case of wrong-direction reasoning, so this point is properly analyzed.
- The final relevance conclusion of 'low-to-medium' is reasonably hedged and appropriately tied to the missing protein base layer limitation, which is legitimate reasoning (a required element in claim 1 is absent from the invention), not wrong-direction logic.

3.26 US8057535B2 — Implantable medical device

Assignee: Nano Vasc Inc · Published: 2011-11-15 · Status: Expired - Fee Related · exp. 2028-06-11 · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Fee Related (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1 requires a covering composition comprising heparin residue (A) covalently linked via a poly(lactide)-based formula, attached to poly(urethane) fibers — this broadly reads on the invention's concept of heparin covalently bonded to a polyurethane-containing surface to reduce thrombus formation.
- Claim 10 recites that the covering composition is integrated into the body by dip coating, which overlaps with the invention's dip-coating application method for applying the heparin-functionalized coating.
- Claim 15's process claim covers applying a primer, immobilizing a linker, and covalently attaching heparin to the linker — a covalent-attachment process broadly analogous to the invention's covalent bonding of heparin, though via a different chemical route (poly(lactide) primer/linker vs. UV curing).
- Claim 18 recites that applying, immobilizing, and attaching steps are accomplished by successive dip coating, which overlaps generically with the invention's dip-coating based fabrication approach.
- Claim 14 covers the device as a tubular vascular graft, which is broad enough to potentially encompass catheter-type tubular medical devices generally, though the invention is specifically a coronary catheter shaft.

Appears to differ (AI reasoning):

- Claim 1 requires a fibrous polymer body comprising electrospun poly(urethane) fiber with a support filament wrapped around it and an outer electrospun layer adhering the filament — the invention's catheter shaft is described as having a polyurethane surface layer without any indication of an electrospun fibrous body/support-filament/outer-layer construction; this structural requirement appears absent from the invention.
- Claim 1 specifies the covering composition comprises poly(lactide) with a defined formula (heparin residue A, integers n and m in specified ranges) — the invention's coating is described only as heparin covalently bonded directly to polyurethane via UV curing, with no mention of a poly(lactide)-based linking polymer, so this specific chemical composition requirement does not appear to be met.
- Claim 15's process requires applying a poly(lactide) primer, then immobilizing a distinct linker molecule via covalent bond to the primer, then covalently attaching heparin to the linker — the invention instead describes direct covalent bonding of heparin to polyurethane fixed by UV curing, lacking the claimed primer/linker intermediate chemistry.

Note: This patent (US8057535B2) centers on an electrospun poly(urethane) fibrous vascular graft/device with a support filament and a poly(lactide)-based primer/linker chemistry for covalently attaching heparin. The invention is a coronary catheter shaft with a polyurethane surface layer directly coated with covalently bonded heparin via dip-coating and UV curing. There is conceptual overlap in the general goal (covalent heparin immobilization on polyurethane substrate to reduce thrombus formation) and in the dip-coating application technique, which are claimed in relatively broad terms (claims 1, 10, 18) that could read on similar approaches. However, claim 1 (the sole independent claim, from which all others depend) imposes specific structural limitations (electrospun fibrous body, support filament, outer layer) and specific compositional limitations (poly(lactide)-containing formula with defined stoichiometric ranges) that do not appear to be present in the invention as described. No claim recites UV curing as the fixation mechanism; claim 15 instead specifies a primer/linker covalent chemistry. Given the shared thrombus-reduction/heparin-immobilization concept but differing structural and chemical implementation, relevance is assessed as medium. This is an informational screening note only, not a legal or infringement opinion. ⚠ LEGAL STATUS (Google Patents): Expired - Fee Related — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note's overlap statement on Claim 1 characterizes it as 'broadly reading on' the invention, but Claim 1 also requires the electrospun fibrous body/support filament/outer layer structure and the poly(lactide) formula, which the note itself later acknowledges as distinguishing — presenting it as overlap first

without that caveat is slightly overstated framing, though the caveat is provided later so it's not fabrication.

- The claim 14 overlap statement ('broad enough to potentially encompass catheter-type tubular medical devices generally') is speculative extrapolation not directly stated in the claims/abstract; claim 14 says 'tubular vascular graft' and dependency from claim 1 (which requires the electrospun body/filament/outer layer structure) makes the extrapolation to 'catheter-type tubular medical devices generally' overstated.
- The distinguishing point about the absence of an electrospun fibrous body/support-filament/outer-layer construction in the invention, and the absence of poly(lactide) formula, is reasoning correctly in terms of non-infringement due to claim limitations not being met by the invention (this is legitimate, not wrong-direction, since it's the invention lacking a required claim element, not the claim failing to recite an invention feature) — no wrong-direction issue found here upon review, but flagging for completeness given the FTO-direction check requested.
- The statement 'No claim recites UV curing as the fixation mechanism' is used as part of the distinguishing analysis; this is factually true from the claims but framed as reducing risk, which risks wrong-direction logic if intended to argue the claims are narrower and thus less likely to be infringed — however since claim 15 requires a different specific mechanism (primer/linker) that the invention doesn't use, this is legitimately distinguishing, not wrong-direction.

3.27 US8403896B2 — Apparatus and methods for making coated liners and tubular devices including such liners

Assignee: AUST Development LLC, AUST Dev LLC · Published: 2013-03-26 · Status: Active · exp. 2029-12-01 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claims broadly recite a 'coating on an inner surface' of an inner liner with properties to decrease resistance to flow or clogging (claims 1, 13, 18), which could potentially read on a functional coating on a catheter lumen surface in generic terms, though the invention's coating is on the outer catheter shaft surface rather than an inner liner surface
- Claim 9 recites an aspiration mechanism for removing thrombus, which shares a general anti-thrombus purpose theme with the invention's anti-thrombogenic function, though directed to removal rather than prevention

Appears to differ (AI reasoning):

- All independent claims (1, 13, 18) require an aspiration lumen, aspiration source, and at least one passive macerating element for cutting/separating aspirated material — the invention as described is a coated catheter shaft with no aspiration lumen, aspiration source, or macerating element
- Claims require the coating to be positioned on an inner surface of an inner liner specifically to address flow resistance or clogging of aspirated material, whereas the invention's coating is a covalently bonded heparin layer on the outer polyurethane surface for anti-thrombogenic purposes unrelated to aspiration flow/clog properties
- Claim 3 specifically requires a 'fibrinolytic coating' as an embodiment, which is compositionally different from a covalently bonded heparin (anticoagulant) coating; no claim recites heparin, covalent bonding, dip-coating, or UV curing
- No claim recites or requires a dip-coating application method or a UV curing fixation step for the coating
- Claims 13 and 18 require an outer tubular layer surrounding the inner liner and (claim 17) an optional reinforcing layer between liner and outer layer, a multi-layer tubular construction not described in the invention's simple polyurethane shaft

Note: This patent is directed to an aspiration/thrombectomy catheter system with a multi-layer tubular device, passive macerating elements, and an aspiration source/lumen — a mechanical thrombus-removal apparatus. The invention is a coronary catheter shaft with a covalently bonded heparin surface coating applied via dip-coating and UV curing to prevent thrombus formation (a passive antithrombogenic surface treatment, not a mechanical aspiration device). The claims' coating limitations are tied functionally to

flow/clog reduction in an aspiration lumen and structurally to an inner liner within a multi-layer aspiration tubular device with a macerating element — limitations the invention appears to lack. Overlap is limited to generic coating-on-a-lumen-surface language; the core apparatus structure (aspiration lumen, source, macerating element) is absent from the invention description. Relevance is assessed as low given the fundamentally different device purpose and required structural elements, though the specific coating chemistry claims (e.g., claim 3's fibrinolytic coating) are not evaluated here as no heparin-specific or covalent-bonding claim language appears in this patent.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing point 'No claim recites or requires a dip-coating application method or a UV curing fixation step for the coating' is wrong-direction FTO reasoning: absence of a limitation in the claims makes the claim broader, not narrower, and thus does not distinguish the invention from the claims — it should be flagged as a risk factor rather than cited as a distinguishing feature.
- Similarly, noting that 'no claim recites heparin, covalent bonding, dip-coating, or UV curing' as a distinguishing point is partly wrong-direction reasoning, since the claims' coating limitations are functionally defined (decrease resistance/clogging) rather than compositionally limited, meaning the absence of these specific recitations does not necessarily exclude the invention from claim scope — this nuance is only partially acknowledged in the note's own caveat about claim breadth versus specific chemistry.

3.28 US8846836B2 — Hyaluronic acid based copolymers

Assignee: Abbott Cardiovascular Systems Inc · Published: 2014-09-30 · Status: Expired - Fee Related · exp. 2024-04-30 · Relevance: LOW · verify on Google Patents ↗

⚠ NOT IN FORCE — Expired - Fee Related (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Both relate to coatings on implantable intravascular devices intended to address thrombosis-related conditions, but the mechanisms differ substantially

Appears to differ (AI reasoning):

- Claim 1 requires a method of treating a disorder by implanting a device comprising a hyaluronic acid (HA) conjugate coupled to a specific biocompatible polymer (poly(tyrosine carbonates), poly(tyrosine ester), poly(imino carbonates), or PBMA) — the invention's polyurethane substrate with heparin coating does not involve HA or any of these enumerated polymers
- Claim 1 requires the HA be functionalized to bear a hydrazide, terminal anhydride, or terminal aldehyde group for conjugation — the invention uses heparin covalently bonded via a different (unspecified) chemistry, not HA functionalization
- Claim 1 requires the device to comprise a 'bioactive agent' (e.g., listed drugs in claim 3 such as paclitaxel, rapamycin, dexamethasone) in combination with the HA conjugate — the invention's heparin coating is not described as paired with such a separate pharmacological bioactive agent
- The claim is drawn to a method of treating a disorder via implantation, not to a coated catheter shaft product or its manufacturing process (dip-coating, UV curing) — the invention as described is a device/coating process, not a treatment method claim, so the claim category itself differs from the invention's apparatus/process focus

Note: This patent's claims are narrowly directed to a treatment method using an implantable device coated with a hyaluronic acid (HA) conjugate bonded to specific listed biocompatible polymers, optionally with a bioactive drug. The invention concerns a polyurethane catheter shaft with covalently bonded heparin applied via dip-coating and UV curing. There is no HA, no listed biocompatible polymer, and no bioactive agent in the invention as described, and the claim is method-of-treatment rather than device/process. Overlap is limited to the general therapeutic area (thrombosis-related) and general concept of a coated implantable device; the specific chemistries and claim structure appear materially different. This is an informational screening note only, not a legal or infringement conclusion. ⚠ LEGAL

STATUS (Google Patents): Expired - Fee Related — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note states the invention's heparin coating is 'not described as paired with such a separate pharmacological bioactive agent' — this is a fair distinguishing point but frames the absence as favorable; since claim 1 requires a bioactive agent, the invention's lack of one is a valid non-infringement basis, which is correctly reasoned (not wrong-direction) in this instance.
- The claim category distinction (method-of-treatment vs. device/process) is valid and correctly reasoned, since claim 1 is indeed limited to a treating method requiring implantation, which is a legitimate narrowing element, not a wrong-direction overbreadth argument.
- Overall the distinguishing points are supported by the claim text and invention features; no fabricated patent content or invented claim limitations were found.

3.29 US8927048B2 — Apparatus and methods for making coated liners and tubular devices including such liners

Assignee: AUST Development LLC · Published: 2015-01-06 · Status: Active · exp. 2031-09-06 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 8/17 broadly recite "an antithrombotic material" as a possible coating, which could generically encompass a heparin-based anti-thrombogenic coating like the invention's
- Claim 18 recites 'drawing the sleeve through a liquid coating material' (dip-coating-like exposure), which is analogous in concept to the invention's dip-coating application step
- Claim 19 recites curing the liquid coating material so that it is bonded to the first surface, which broadly overlaps with the invention's UV curing step to fix covalent bonds, though the claim does not specify UV or covalent bonding mechanism

Appears to differ (AI reasoning):

- The claims are directed to a manufacturing process involving providing a sleeve, coating one surface, cutting it, reversing it to become an inner liner surface, and attaching an outer tubular structure/reinforcing layer — the invention as described is a coated catheter shaft product/coating chemistry, not this specific liner-reversal tube-building process, and there is no indication the invention performs the cut-and-reverse liner construction required by claims 1, 15, and 22
- Independent claims 1 and 22 require attaching a handle or hub to the tubular device and attaching a separate reinforcing/tubular structure around the coated liner; the invention description does not mention such construction steps
- Claim 1/15 require maintaining tension via rollers/guides during cutting and reversing steps, and a substantially continuous process (claim 15) — features not present in the invention's described dip-coating/UV-curing process on a preformed shaft
- The claims' coating is applied to a sleeve surface that is later reversed to become the lumen-facing surface; the invention coats the polyurethane catheter shaft's surface layer directly via dip-coating without any cut/reverse liner step, so the specific coating application context differs substantially

Note: This patent claims a specific tube/liner manufacturing process (coat a sleeve, cut it, reverse it to place the coated surface on the inside, then build a tubular device with reinforcing layers and a hub) rather than a coating chemistry or a coated catheter shaft per se. Only the generic coating material limitation (e.g., 'antithrombotic material' in claims 8/17) and the dip/cure steps in claims 18-19 have surface-level conceptual overlap with the invention's heparin dip-coating and UV curing. However, the invention as described appears to be a finished catheter shaft coated with covalently-bonded heparin via dip-coating and UV cure, with no indication of the claimed cut-sleeve-and-reverse liner fabrication process, reinforcing layer attachment, or hub attachment steps that form the core of every independent claim. Because the independent claims require this specific liner-construction methodology (missing from the invention description), overall relevance is assessed as low, notwithstanding the coating-material and

curing overlaps in dependent claims 8, 17, 18, and 19. This is an informational screening note only, not a legal or infringement conclusion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing points repeatedly frame the absence of the invention's cut-and-reverse liner process, reinforcing layer attachment, and hub attachment as a basis for reduced relevance/risk; however, since these are limitations required by the claims (not absent from them), this is proper claim-scope reasoning (narrower claim due to added steps means less overlap), not wrong-direction reasoning — this part is faithful and not an issue.
- The statement 'Claim 19 recites curing the liquid coating material so that it is bonded to the first surface, which broadly overlaps with the invention's UV curing step... though the claim does not specify UV or covalent bonding mechanism' is acceptable as an overlap description, but bears watching: noting the claim does NOT specify UV/covalent bonding as a similarity-limiting factor is correct since the claim's silence makes it broader, not narrower, and the note correctly does not use this omission to distinguish/minimize risk, so it is not wrong-direction.
- The overall conclusion that 'relevance is assessed as low' because the independent claims require the liner-construction methodology is reasonable and correctly grounded in claim requirements rather than in the invention's lacking a feature the claim doesn't recite, so it does not commit the wrong-direction fallacy.
- Claim 8/17 and 18/19 overlap statements are accurately quoted and supported by the claim text provided.
- No fabricated patent content was found; all claim references are accurate to the provided text.

3.30 US10016533B2 — Plasma modified medical devices and methods

Assignee: Individual · Published: 2018-07-10 · Status: Active · exp. 2031-11-01 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both relate to catheter surface treatments intended to reduce thrombosis, and claim 8/20 broadly list catheters among covered medical devices, which could encompass a coronary intervention catheter as the device type
- Both involve covalently bonding a bioactive/functional agent to a device surface, a conceptual overlap in bonding chemistry approach

Appears to differ (AI reasoning):

- Claims 1 and 9 require a two-step plasma deposition process (a silicon-containing monomer plasma layer followed by a nitrogen/oxygen plasma layer) — the invention uses dip-coating and UV curing, not plasma deposition, so this required process step appears absent
- Claims require covalent bonding of nitric oxide (NO) functional groups specifically, generated from nitrogen- and oxygen-containing plasma molecules — the invention covalently bonds heparin molecules, a different chemical agent, which does not meet this specific compositional limitation
- Claims require the plasma coating layer(s) be less than 100 nm (and further limited to <60nm, <20nm, or 10-20nm in dependent claims) formed via plasma deposition — the invention's dip-coating/UV process has no described plasma layer thickness limitation of this kind
- Claim 1 requires a silicon-containing monomer selected from a specific list (e.g., TMS, vinyltrichlorosilane, etc.) as a base layer — the invention's polyurethane surface layer with heparin functionalization does not include this silicon-containing plasma layer
- Claim 9's second coating step and dependent claims (10, 11) are directed to plasma-based restenosis/adhesion effects tied to the two-step plasma process — the invention's anti-thrombogenic effect is achieved via a different heparin-based covalent chemistry, not plasma modification

Note: This patent's claims are narrowly drawn to a specific two-step plasma deposition/modification method producing covalently bonded nitric oxide functional groups, with process-specific limitations

(monomer identity, plasma layer thickness, plasma gas mixtures). The invention as described uses dip-coating in a heparin solution with UV curing to covalently bond heparin (not NO) to a polyurethane surface — a materially different coating chemistry and deposition process. Overlap appears limited to the general device category (catheters, claim 8/20) and the shared functional goal of reducing thrombosis, which is insufficient to establish overlap with the specific method steps claimed. Relevance is scored low given the divergent core technology (plasma-based NO functionalization vs. wet-chemistry heparin covalent attachment). This is an informational screening note only, not a legal or infringement opinion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement 'Both involve covalently bonding a bioactive/functional agent to a device surface, a conceptual overlap in bonding chemistry approach' is a generalization not directly supported by specific textual overlap beyond the shared term 'covalently bonding' — this is a reasonable but somewhat loosely framed inference, bordering on overstatement since the chemistries (NO via plasma vs. heparin via wet chemistry) are fundamentally different.
- The distinguishing point regarding claim 1's silicon-containing monomer list and plasma layer thickness limitations is used correctly to distinguish, but the note's framing that these specific limitations mean 'the invention's dip-coating/UV process has no described plasma layer thickness limitation of this kind' is fine, though it edges toward emphasizing absence of a feature in the invention rather than absence of a claim limitation reading on the invention — this is directionally acceptable since narrower claim limitations here do genuinely narrow scope, so it is not a wrong-direction FTO error.
- The note's claim 8/20 catheter overlap point is faithful to the text, but stating it 'could encompass a coronary intervention catheter' is a slight speculative extension since the claims do not specify coronary intervention catheters explicitly.

3.31 CN112316218B — A kind of zwitterionic polymer and heparin composite coating and preparation method and application thereof

Assignee: Northwest University · Published: 2021-12-10 · Status: Active · exp. 2040-10-26 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both involve heparin covalently bonded to a polymer surface layer on a medical device to reduce thrombus formation/improve anticoagulation, which is the core functional concept in claim 1's heparin anticoagulant layer limitation.
- Both use immersion/dip-type processing (claim 5 steps (1)-(3) require immersing the substrate in aqueous/EDC-NHS solutions), which broadly overlaps with the invention's dip-coating application step.
- Claim 9 covers application of the coating to any biomedical device surface contacting bodily fluids, a broad category that could encompass a coronary catheter shaft.

Appears to differ (AI reasoning):

- Claim 1 requires a specific multi-layer architecture: a mediating layer formed from a 'bionic universal adhesion material A' (e.g., dopamine hydrochloride) combined with a crosslinker B (silane, PEI, or polylysine) directly on the substrate — the invention's polyurethane shaft with directly bonded heparin does not appear to include this mediating layer.
- Claim 1 further requires a zwitterionic polymer layer (2-10 nm, of formula (I) with PC/SB/CB zwitterionic groups) anchored to the mediating layer, with heparin covalently bonded to the zwitterionic polymer layer surface (not directly to the base polymer) — the invention appears to bond heparin directly to the polyurethane surface without an intervening zwitterionic polymer layer.
- Claim 5's preparation method requires EDC/NHS-catalyzed amidation chemistry for both zwitterionic polymer anchoring and heparin grafting steps; the invention instead uses a UV curing step to fix covalent bonds, which is a different fixation chemistry not required or described in the claims.
- Claim 1 specifies a minimum heparin surface density (≥0.2 μg/cm²) and claim 4 specifies heparin sodium molecular weight (4000-10000); no corresponding heparin loading/molecular weight

parameters are mentioned for the invention, so this claim limitation's applicability cannot be confirmed.

Note: This patent claims a specific three-tier composite coating (bionic adhesive mediating layer + zwitterionic polymer layer + covalently bonded heparin layer) built via sequential immersion and EDC/NHS amidation chemistry. The invention's coating appears to be a simpler two-component system (heparin directly covalently bonded to a polyurethane surface via dip-coating and UV curing) lacking the mediating adhesive layer and zwitterionic polymer layer that are explicit, structurally required elements of claim 1 and the process claims. While the general concept of covalent heparin immobilization for anti-thrombogenic purposes shows conceptual overlap, the claims' specific layered structure and EDC/NHS-based chemistry appear to be missing from the described invention, suggesting a lower likelihood of literal overlap, though equivalents analysis of the heparin-bonding chemistry may warrant further review. This is an informational screening note only, not a legal or infringement opinion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The last distinguishing point ('no corresponding heparin loading/molecular weight parameters are mentioned for the invention, so this claim limitation's applicability cannot be confirmed') is framed as a distinguishing point but is actually an acknowledged uncertainty, not a true distinction; listing it under 'Distinguishing points' slightly overstates the case for non-overlap.
- The characterization of claim 5's immersion steps as 'broadly overlaps with the invention's dip-coating application step' is a reasonable but generous reading of 'immersing' as equivalent to 'dip-coating'; this is a minor stretch though defensible from the claim text.
- The overall conclusion emphasizes that claim 1 requires additional layers (mediating layer, zwitterionic layer) that the invention lacks, and uses this to suggest lower overlap risk for claim 1 specifically; this reasoning is directionally appropriate for dependent/narrow independent claims, but the note does not adequately flag that claim 9 (device application) and the general immersion-based process could still pose risk regardless of the invention lacking those extra layers — this is only partially addressed and could be seen as slightly underweighting broader claim risk.

3.32 EP3860669B1 — Medical devices

Assignee: MicroVention Inc · Published: 2024-04-03 · Status: Active · exp. 2039-10-01 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 14 recites 'coupling is by dip coating, spraying, brushing, or a combination thereof' as a method for applying the claimed polymer to a device surface — the invention's dip-coating application step is a generic technique that overlaps with this method limitation, though only as applied to the different polymer chemistry claimed in claims 1-5.
- Claim 6 recites an outer surface 'covalently coupled' to the polymer, which is broad phrasing regarding covalent attachment of a coating to a device surface — conceptually similar to the invention's covalent heparin-to-polyurethane bonding, though the chemical identity of the bonded species differs (see distinguishing points).

Appears to differ (AI reasoning):

- Claim 1 requires the coating to be 'a polymer prepared from free radical polymerization' of specific alkoxyalkylacrylate/(tetrahydrofuran-2-yl)methyl acrylate first monomers and defined silane-containing second monomers; heparin (a polysaccharide/biologic) as described in the invention does not appear to fall within this defined synthetic polymer composition, so this core compositional limitation appears unmet.
- Claim 12 requires a specific activation sequence — 'activating a surface... by hydroxylation, optionally further... argon plasma treatment' — prior to polymer coupling; the invention's disclosed process (dip-coating in heparin-functionalized solution followed by UV curing) does not mention any hydroxylation or plasma activation step, so this claimed method limitation appears absent.

- Claim 13 further specifies particular oxygen/argon plasma parameters (flow rates, power, pressure, time) for the hydroxylation step, which have no counterpart in the invention's UV-curing-based fixation process.
- Claims 8-11 and 15-16 limit the 'article of manufacture'/medical device to an expandable tubular body (e.g., stent, flow diverter) often including specific metals/alloys, used for vascular stenosis or aneurysm treatment; the invention is a coronary catheter shaft, which does not appear to be an expandable tubular metal implant as required by these claims.
- The invention's fixation mechanism is described as 'UV curing,' whereas the patent's claims specify free-radical-polymerization-derived polymer coupled via a hydroxylation/plasma-activated surface chemistry — these appear to be different chemical fixation approaches, though some equivalency uncertainty exists given limited process detail in the invention description.

Note: This is an informational screening comparison only, not a legal or infringement opinion. The patent's claims are centered on a specific synthetic acrylate/silane-based polymer and its coupling method (via plasma/hydroxylation activation) to implantable metal devices such as stents or flow diverters. The invention instead involves a heparin coating covalently bonded to a polyurethane catheter shaft via dip-coating and UV curing. The chemical composition of the coating differs substantially (defined synthetic acrylate copolymer vs. heparin), and the claimed activation method (hydroxylation/plasma) is not described in the invention, both of which appear to be missing-element type differences. Overlap is limited mainly to generic process language (dip-coating) and the general concept of a covalently coupled surface coating, which are common to many coating patents and do not indicate close subject-matter alignment. Overall relevance is assessed as low given the divergent chemistry and device type, though further review of claim scope for 'polymer' definitions and any related family members directed to biologic coatings could refine this assessment.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note treats independent claim 1 (the polymer composition) as if it is the operative claim against which the invention's dip-coating and covalent-bonding features must be compared, but claim 1 does not require dip-coating or a specific activation method — those limitations only appear in dependent method claims 12-14, which depend on claims 1-5. The distinguishing arguments based on claim 12's hydroxylation/plasma requirement and claim 13's specific plasma parameters are only relevant to method claims 12-14, not to the broader composition claim 1 or article claims 6-7, so citing absence of hydroxylation as a reason claim 12 is 'unmet' is directionally fine (narrower claim, easier to avoid) but the note somewhat conflates this with overall distinguishing strength, understating that broader claims (1, 6, 7) lack these limitations and are therefore harder to avoid — this is a wrong-direction risk understatement rather than fabrication.
- The claim 6 'covalently coupled' language is optional ('optionally wherein the polymer is covalently coupled') and applies specifically to the defined acrylate/silane polymer of claims 1-5, not to any covalent coating generally; describing it as 'broad phrasing regarding covalent attachment of a coating to a device surface' generically overstates the claim's actual scope, which is tied to the specific polymer already defined in claim 1.
- The overlap statement on claim 14 (dip coating) correctly notes it applies only to the claimed polymer chemistry, which is appropriately caveated, but framing it as 'potential overlap' while the composition is entirely different is a stretch — dip-coating alone read against a claim requiring a specific free-radical-polymerized acrylate/silane polymer is unlikely to constitute meaningful overlap, making this overlap point overstated relative to actual risk.

3.33 CN114845746A — UV-cured coatings for medical devices

Assignee: Biocoatings Srl · Published: 2022-08-02 · Status: Active · exp. 2040-10-21 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 15/11/1: patent covers a photoreactive primer coating on a catheter substrate, generically encompassing catheter shafts, which could overlap with the invention's polyurethane catheter shaft substrate if such primer were used

- Claim 21/23: patent claims a method of curing the primer/topcoat layer using UV light, which is broadly analogous to the invention's UV curing step to fix coating bonds, though applied to a different chemistry
- Claim 16: patent claims covalent crosslinks between a primer layer and hydrophilic topcoat, which is a structurally similar concept (covalent bonding within a coating stack) to the invention's covalently bonded heparin coating, though the bonded species and chemistry differ
- Claim 44: patent's lubricious coating may contain a 'pharmaceutical agent' blended with the composition, which could be read broadly enough to encompass an anti-thrombogenic/heparin-like agent, though heparin is not named

Appears to differ (AI reasoning):

- Claims require the coating polymer to be made from specific photoactive monomers (e.g., benzophenone-based hydrogen-atom-extractant monomers) copolymerized with acrylate/acrylamide/NVP monomers in defined mole percentages/Tg ranges; the invention's heparin-functionalized polyurethane coating does not appear to involve this monomer-based photopolymer chemistry
- Claims 1, 24 require specific molar ratios (20:1–500:1) of acidic/acrylate monomers to photoradical generator groups; no such compositional ratio is described for the invention's heparin coating
- Independent claims are directed to primer/topcoat polymer compositions built from acrylate, acrylamide, NVP, or acidic olefinic monomers; heparin (a polysaccharide anticoagulant) as the active bonded species is not recited or suggested in any claim
- No claim recites heparin or an anti-thrombogenic/anticoagulant agent as the bonded/functional species — claim 44's 'pharmaceutical agent' is generic and does not specifically require an anticoagulant, so the core anti-thrombogenic heparin chemistry of the invention lacks a corresponding required element in these claims

Note: This patent's claims are directed to photoreactive (benzophenone/hydrogen-atom-extraction) primer and hydrophilic topcoat polymer compositions and their UV-curing methods for medical devices/catheters generally. There is structural/process-level analogy in the use of a catheter substrate, UV curing, and covalent crosslinking within a coating stack, which constitutes potential overlap at a general conceptual level. However, the claims are compositionally tied to specific acrylate/acrylamide/benzophenone-derived polymer chemistries and do not recite heparin or covalent heparin-polyurethane bonding as the active anti-thrombogenic mechanism, which is the core of the invention. Overall relevance is assessed as low given the divergent chemistries, but the shared UV-curing and covalent-crosslink concepts warrant a cautious informational note rather than a clean dismissal.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note's distinguishing points repeatedly argue that because the claims do not recite heparin or the invention's specific chemistry, the invention is distinguished — this is wrong-direction FTO reasoning: claims not reciting a feature of the invention does not narrow the claim relative to the invention, and broad/generic claim language (e.g., 'pharmaceutical agent or antimicrobial agent' in claim 44, or generic catheter substrate in claim 15) could still read onto the invention, which is the more dangerous direction for FTO purposes.
- The statement that 'no claim recites heparin...so the core anti-thrombogenic heparin chemistry of the invention lacks a corresponding required element in these claims' is used as a basis to lower overlap risk, but this is backwards: the absence of a heparin limitation in claim 44 potentially means the claim is broader and could read on heparin as a 'pharmaceutical agent,' increasing rather than decreasing risk — the note treats broad/generic claim scope as favorable when it is actually a risk factor.
- The claim 15/11/1 overlap statement calls the primer claim 'generically encompassing catheter shafts, which could overlap... if such primer were used' — this is speculative framing but is reasonably supported by claim 15's explicit recitation of catheters, so it is only mildly overstated, not fabricated.
- The characterization of claim 16 covalent crosslinks as 'structurally similar' to heparin covalent bonding is a reasonable analogy grounded in the claim text, though the note appropriately caveats that the bonded species differ — this is faithful but the overall analogy is somewhat thin.

3.34 CN114432504B — A surface treatment composition, a balloon microcatheter with the composition and a preparation method thereof

Assignee: Suzhou Hao Microbial Medical Technology Co ltd · Published: 2023-06-20 · Status: Active · exp. 2042-01-30 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 requires a heparin-based anticoagulant coating applied to a catheter body, dip-coated (浸入) into a coating solution and fixed via UV curing (紫外光固化), which overlaps with the invention's dip-coating and UV curing fixation steps for heparin coating
- Claim 1's process of immersing the heparin-coated tube body in a hydrophilic coating solution followed by UV curing overlaps with the invention's dip-coating application method and UV curing fixation step
- The general concept of an anti-thrombogenic/anticoagulant coating on a catheter body to reduce thrombus formation overlaps with the invention's anti-thrombogenic functional purpose
- Claim 1 requires heparin as the anticoagulant material, overlapping with the invention's heparin coating component

Appears to differ (AI reasoning):

- Claim 1 requires the coating to be a composite of PVP (polyvinylpyrrolidone) as the hydrophilic material combined with heparin, whereas the invention describes heparin covalently bonded directly to a polyurethane surface layer without a PVP-based hydrophilic layer
- Claim 1 requires a specific two-layer process: pretreatment with polyethyleneimine or benzalkonium chloride solution, drying, then a heparin anticoagulant coating, then a separate PVP-based hydrophilic topcoat cross-linked with a crosslinker/initiator, which the invention does not appear to include
- Claim 1 requires the hydrophilic coating solution to include a cross-linking agent and initiator as part of the UV-cured layer, a formulation detail not mentioned in the invention's description of covalent heparin-polyurethane bonding

Note: This patent claims a two-component surface treatment (heparin anticoagulant sublayer + PVP hydrophilic topcoat, UV-cured) for balloon microcatheters, prepared via a specific pretreatment/dip/UV-cure sequence. The invention's heparin dip-coating and UV-curing steps show potential overlap with claim 1's process elements (dip-coating into solution, UV curing to fix coating), and both target anti-thrombogenic/anticoagulant function. However, claim 1 requires a specific composite structure combining heparin with a PVP hydrophilic layer plus specific pretreatment chemistry (polyethyleneimine/benzalkonium chloride, crosslinker, initiator) that is not described in the invention's simpler covalent heparin-to-polyurethane bonding scheme. Relevance is medium given process-step similarities but differing coating chemistry/architecture. This is an informational screening note only, not a legal or infringement conclusion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note states UV curing in Claim 1 fixes the covalent bonds between heparin and polyurethane, but the claim text specifies UV curing is applied to the hydrophilic PVP topcoat solution, not to fix heparin bonding to a polyurethane substrate (the patent claim does not mention polyurethane at all) — this is a mischaracterization of what is being cured.
- The note characterizes the overlap as 'dip-coating into a coating solution and fixed via UV curing' for the heparin coating itself, but per claim 1 the heparin coating is applied via immersion in heparin solution (step C) and vacuum dried, while UV curing is applied only to the subsequent PVP hydrophilic layer (step D) — conflating these two distinct steps overstates the process overlap.
- The distinguishing point that 'Claim 1 requires the coating to be a composite of PVP... whereas the invention describes heparin covalently bonded directly to a polyurethane surface layer without a PVP-based hydrophilic layer' is a wrong-direction FTO argument: the absence of PVP in the invention does not avoid infringement of a claim that also covers heparin-based anticoagulant coatings if other elements read on it, and pointing to the invention's simpler structure as distinguishing does not analyze whether

Claim 1 broadly reads onto simpler embodiments; however since Claim 1 explicitly requires PVP and pretreatment chemistry, this could be legitimate — but the reasoning quality is not fully wrong-direction here since the invention lacks required elements, so this is a minor/borderline issue rather than a clear fabrication.

- The note's claim that Claim 1 requires the anticoagulant material to be heparin is only accurate for claim 1 as drafted (correctly narrowed from the abstract's broader list), which is faithful, but the note does not flag that the abstract describes a broader set of anticoagulants (hirudin, sodium citrate, potassium fluoride) which could be relevant to related claims not fully quoted, a minor omission rather than fabrication.

3.35 HK40046542B — Improvements to processes for immobilising biological entities

Assignee: Carmeda Ab · Published: 2023-12-08 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both involve a solid object/catheter-type surface bearing a covalently attached heparin (anticoagulant) moiety for anti-thrombogenic purposes, which overlaps generically with the invention's covalently bonded heparin coating and its anti-thrombogenic functional purpose
- Claim 1 and claim 12 broadly claim a solid object/process producing a surface with covalently attached heparin without limiting the underlying substrate material, which could generically encompass a polyurethane catheter shaft substrate as one type of 'solid object'

Appears to differ (AI reasoning):

- Claims 1 and 16 require a specific multi-layer process using alternating cationic polymer and anionic polymer (dextran sulfate) treatments (steps i-v), including specific molecular weight (650-10,000 kDa) and sulfur content (10-25 wt%) ranges for the anionic polymer, and a specific salt concentration range (0.25M-5.0M) during anionic polymer treatment — the invention's described dip-coating/UV curing process does not appear to include this layered cationic/anionic polymer buildup or these compositional/concentration parameters
- Claim 1 specifies attachment of the anticoagulant entity by treating the outermost cationic polymer layer with heparin to covalently attach it to that layer, whereas the invention describes direct covalent bonding of heparin to a polyurethane surface layer without an intervening cationic/anionic polymer layered architecture
- The claims require dextran sulfate specifically as the anionic polymer component of the coating system; the invention's description does not mention dextran sulfate or any anionic/cationic polymer layering at all
- The claims are directed to a layered ionic polymer deposition process (akin to layer-by-layer polyelectrolyte assembly) rather than a dip-coating in a heparin-functionalized solution followed by UV curing, which is the invention's specific application and fixation method

Note: Claims text provided appears complete and relates to a layer-by-layer (cationic/anionic polymer) heparin immobilization process with specific compositional and concentration parameters. The invention's simpler polyurethane-heparin covalent coating via dip-coating and UV curing does not clearly include the claimed dextran sulfate anionic polymer layer or the specified molecular weight/sulfur content/salt concentration parameters, so many limitations in claims 1 and 16 (independent claims) appear to require elements not evidently present in the invention description. However, the general concept of covalently bound heparin on a device surface for anticoagulant purposes shows conceptual overlap warranting closer technical comparison, particularly regarding equivalents in coating chemistry.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement about claims 1 and 12 broadly encompassing 'any solid object' without limiting substrate material is overstated as a basis for overlap risk in the wrong direction potentially, but it is actually correctly identifying broad claim scope as a risk (this is proper direction), so not an issue.
- The distinguishing point stating 'the invention's dip-coating/UV curing process does not appear to include this layered cationic/anionic polymer buildup' is factually supported by the invention features (no mention

of cationic/anionic layering), so this is legitimate distinguishing reasoning based on affirmative claim limitations, not wrong-direction reasoning.

- The note's final paragraph reasoning that 'the invention's simpler...coating...does not clearly include the claimed dextran sulfate anionic polymer layer' is valid since these are required limitations of the claims (narrowing elements), not absent limitations - this is correct direction (invention lacks limitation required by claim, so no infringement), which is appropriate.
- The claim 16 reference is imprecise: claim 16 (the third independent claim) does not require a heparin/anticoagulant step at all (steps i-iv only, ending with cationic polymer, no anticoagulant treatment step), so citing it as also requiring 'specific salt concentration' and 'anticoagulant entity attachment as in claim 1' is slightly conflated since claim 16 doesn't include the anticoagulant attachment step v) that claim 1 has; the note groups claim 16 with claim 1's heparin-attachment distinguishing point somewhat imprecisely.

3.36 HK40046542A — Improvements to processes for immobilising biological entities

Assignee: Carmeda Ab · Published: 2021-11-05 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both concern covalent immobilization of a heparin moiety onto a device surface to confer anticoagulant/anti-thrombogenic properties, which is the same general purpose as claim 1's covalently attached anticoagulant entity
- Both apply the heparin-containing coating to a solid medical device surface, potentially reading on the catheter shaft as a 'solid object' in claims 12 and 17

Appears to differ (AI reasoning):

- Claims 1 and 17 require a specific multi-step layered cationic/anionic polymer construction (steps i-v with cationic polymer then anionic polymer, optionally repeated) — the invention as described uses a single dip-coating step onto a polyurethane surface with no disclosed layered polyelectrolyte architecture
- Claims require the anionic polymer to be dextran sulfate with a defined molecular weight range (650-10,000 kDa) and sulfur content (10-25% by weight) — the invention does not mention any anionic polymer or dextran sulfate component at all
- Claims require the anionic polymer/dextran sulfate deposition step to occur at a specific salt concentration (0.25 M-5.0 M) — no salt-concentration-controlled deposition step is described in the invention
- Claims 1 and 17 require heparin to be covalently attached to an outermost cationic polymer layer (not directly to the base substrate) — the invention describes heparin bonded directly to the polyurethane surface layer itself, lacking the intervening cationic polymer layer required by the claims
- Dependent claims specifying a polyamine cationic polymer and end-point (reducing-end) heparin attachment describe chemistry not disclosed in the invention, which instead relies on UV curing to fix covalent bonds — a fixation mechanism not referenced anywhere in the claims

Note: The patent claims a specific multilayer polyelectrolyte (cationic/anionic polymer) construction using dextran sulfate as the anionic layer, deposited under defined salt-concentration and molecular-weight/sulfur-content parameters, with heparin covalently bound to the outer cationic layer. The invention's simpler direct dip-coating of heparin onto a polyurethane shaft with UV-curing fixation shares the general anticoagulant/covalent-heparin concept but appears to lack the mandatory multilayer, dextran-sulfate, and salt-concentration process steps that are central limitations of every independent claim. This is a screening-level comparison only; actual claim scope should be assessed by a qualified patent professional.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The last bullet under distinguishing points states that dependent claims specifying UV curing 'a fixation mechanism not referenced anywhere in the claims' is used as a distinguishing point — this is wrong-direction reasoning: the claims not reciting the invention's UV curing step does not narrow the claims away from the invention; absence of a limitation in the claims makes the claim broader and potentially more likely to read on the invention, not less relevant to FTO risk.
- The dependent claims bullet lumps together polyamine cationic polymer and end-point heparin attachment as 'chemistry not disclosed in the invention' to support distinction, but since these are dependent (narrowing) claims, the independent claims (1 and 17) remain the primary FTO risk regardless of dependent claim specifics; framing this as a meaningful distinguishing point somewhat overstates its relevance to overall FTO risk from the broader independent claims.

3.37 CN103596603A — Fixed biological entity improvements

Assignee: WL Gore and Associates Inc · Published: 2014-02-19 · Status: Active · exp. 2032-03-09 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both concern covalent bonding of heparin to a polymeric coating on a medical device surface to reduce thrombus formation (claims 1-2, 29, 53), which overlaps with the invention's anti-thrombogenic covalently-bonded heparin coating and its medical device application (catheter).
- Claim 29 broadly recites 'the device is a medical device,' which would encompass a coronary intervention catheter.
- The general concept of manufacturing methods reacting functional end groups with an anticoagulant entity to form covalent bonds (claims 33-36) is broad enough to potentially read on processes that produce covalently bonded heparin coatings generally.

Appears to differ (AI reasoning):

- Claim 1 (and dependent claims 2-32, and independent claims 39, 53-55) require the outer coating to comprise a specific 'cationic hyperbranched polymer molecule' with defined core moiety MW (14-1,000Da), total MW (1,500-1,000,000Da), and a total:core MW ratio of at least 80:1 acting as an intermediary to which the anticoagulant (heparin) is covalently bound. The invention as described bonds heparin directly to the polyurethane surface layer without any disclosed hyperbranched polymer intermediary structure, so this core structural limitation appears absent.
- Claims 33-38 method claims require reacting hyperbranched polymer functional end groups with the anticoagulant before or during attachment to the device surface; the invention's dip-coating in a 'heparin-functionalized solution' followed by UV curing does not describe use of a hyperbranched polymer as required by these claims.
- Dependent claims specifying particular hyperbranched polymer types (PAMAM, PEI, dendrimers), core moieties (ethylenediamine), linker chemistries (secondary amine, amide, thioether, triazole via free-radical initiated reactions), and spacers (PEG) are all specific limitations not addressed or apparently present in the invention's description, which relies on direct covalent bonding and UV curing rather than these defined linker/polymer chemistries.

Note: This patent's claims are centered on a specific cationic hyperbranched polymer scaffold (with defined molecular weight ratios) as an obligatory intermediary for covalently attaching an anticoagulant (e.g., heparin) to a device surface, rather than direct covalent heparin attachment to the substrate. The invention as described lacks any mention of a hyperbranched polymer intermediary, core/total molecular weight characteristics, or the specific linker chemistries recited across the claim set. Overlap exists at a general conceptual level (covalent heparin bonding, anti-thrombogenic medical device coatings), but the claims' defining structural requirement (the hyperbranched polymer with specified MW ratio) is a limitation the invention appears to lack, which is significant under missing-element logic. This is an informational screening note only, not a legal or infringement conclusion; full claims construction and expert review of coating chemistry would be needed for a definitive assessment.

3.38 CN120168732A — A method and product for preparing a hydrophilic and lubricating anticoagulant coating

Assignee: Fengkaili Medical Instrument Shanghai Co ltd · Published: 2025-06-20 · Status: Pending · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 8 lists polyurethane as an option for the substrate material, overlapping with the invention's polyurethane surface layer
- The overall goal of producing a covalently bonded, anticoagulant/anti-thrombogenic heparin coating on a medical device substrate is common to both, creating conceptual overlap at a high level
- Claim 10 covers an interventional/implantable medical article bearing the resulting anticoagulant coating, which could generically encompass a coated catheter shaft product

Appears to differ (AI reasoning):

- Claim 1 requires an amino-functionalized target surface as a starting point; the invention's polyurethane surface is described as receiving a heparin coating directly, with no indication of an amino-functionalization pretreatment step
- Claim 1 requires a distinct 'bonding a hydrophilic polymer' step using a specific hydrophilic polymer (formed from defined formula (1-a)/(1-b) monomers, MW 1000-250000) reacted with the amino surface via an organic base catalyst — the invention has no disclosed intermediate hydrophilic polymer layer or such catalyzed ester-amine chemistry
- Claim 1 requires a separate 'bonding polyethyleneimine' step, covalently linking PEI to the hydrophilic polymer layer before heparin attachment; the invention does not describe any polyethyleneimine intermediate layer
- Claim 1's heparin-binding step specifically reacts heparin hydroxyl groups with PEI-derived amino groups; the invention's heparin appears to be covalently bonded directly to the polyurethane surface (via a dip-coating/UV-curing process), which is a different bonding chemistry and lacks the required PEI intermediary
- The claimed process relies on wet-chemistry reactions with organic base/condensing-agent catalysts (claim 7) rather than a UV curing fixation step, which is the invention's specific cure mechanism and is not recited anywhere in the claims
- Dependent claims 2-7 add further specific monomer, concentration, temperature/time, and buffer/catalyst limitations for the multi-step process that have no counterpart in the invention's simpler dip-coat/UV-cure approach

Note: This patent's claims describe a multi-step, chemically specific process (amino-functionalization → hydrophilic polymer bonding → polyethyleneimine bonding → heparin bonding via amino-hydroxyl coupling) for producing a hydrophilic anticoagulant coating, optionally on polyurethane and similar substrates. The invention's simpler single-layer, direct heparin-to-polyurethane covalent bonding via dip-coating and UV curing does not clearly contain the claimed intermediate hydrophilic-polymer and polyethyleneimine bonding steps, which appear to be required elements of claim 1. Overlap exists at the level of substrate material choice and general anticoagulant/anti-thrombogenic purpose, but the specific claimed reaction scheme appears substantially different from the invention's described process. This is an informational screening note only, not a legal or infringement opinion; a full technical/legal comparison against the actual reaction chemistry used in the invention would be needed for a definitive assessment. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

3.39 EP3332817B1 — Devices with anti-thrombogenic and anti-microbial treatment

Assignee: Teleflex Medical LLC · Published: 2021-05-05 · Status: Active · exp. 2034-03-10 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both involve a medical device external surface coating intended to reduce thrombus formation (anti-thrombogenic purpose), which is broadly analogous to the claim's stated use 'inhibiting...thrombogenesis in a patient'.

Appears to differ (AI reasoning):

- Claim requires the treatment solution to contain at least 0.05% (wt/vol) alexidine, an anti-microbial agent; the invention's coating uses covalently bonded heparin with no indication of alexidine or any anti-microbial component, so this compositional limitation does not appear to be met.
- Claim requires greater than 2% (wt/vol) soluble polymer as a solution component; the invention describes heparin covalently bonded to a polyurethane surface layer via dip-coating/UV curing, not a soluble-polymer-based solution matching this concentration limitation.
- Claim requires a specific solvent system built around tetrahydrofuran (THF) combined with methanol, ethanol, isopropyl alcohol, and/or citric acid; the invention's process (dip-coating in a heparin-functionalized solution followed by UV curing) does not indicate use of any THF-based solvent system, so this claim limitation appears absent.
- The claim is directed to a solution-based surface treatment combining anti-microbial (alexidine) and anti-thrombogenic functions together; the invention's coating is heparin-only and anti-thrombogenic in purpose, lacking the anti-microbial component required by the claim.

Note: This is an informational screening note, not a legal opinion. The claim is narrowly drawn around a specific chemical solution (alexidine + soluble polymer + defined THF-based solvent systems) rather than a generic anti-thrombogenic coating concept. Because several specific compositional elements (alexidine, particular solvent system, polymer concentration) are affirmatively required by the claim and do not appear to be present in the described heparin/polyurethane/UV-cured invention, overlap appears limited to the general functional goal of thrombus reduction rather than the specific claimed chemistry. Verbatim claim text was provided and used as the basis for this comparison; no dependent claims were provided for further analysis.

3.40 ES2953184T3 — Improvements in immobilization processes of biological entities

Assignee: Carmeda AB · Published: 2023-11-08 · Status: Active · exp. 2039-03-08 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1/12 broadly require covalent bonding of a heparin moiety (anticoagulant entity) to an outer cationic polymer layer to reduce thrombogenicity, which is conceptually similar to the invention's covalent bonding of heparin to a polyurethane surface for anti-thrombogenic purposes — potential overlap on the general concept of covalently immobilized heparin on a device surface.
- The claimed anticoagulant entity is explicitly a heparin moiety, matching the invention's heparin coating material, raising potential overlap on the choice of active agent.

Appears to differ (AI reasoning):

- Claims 1 and 12 require a specific layered polyelectrolyte structure (alternating cationic polymer and anionic polymer layers, with anionic polymer being dextran sulfate having defined MW 650-10000 kDa and sulfur content 10-25 wt%) as the substrate for heparin attachment; the invention's substrate is a polyurethane surface layer directly bonded to heparin, with no disclosed cationic/anionic layered polyelectrolyte buildup — this layered polymer architecture appears to be a required element the invention lacks.
- Claims 1 and 12 require the anionic polymer treatment step to be carried out at a specific salt concentration (0.25 M–5.0 M); the invention's dip-coating/UV curing process does not describe any such salt-concentration-controlled polyelectrolyte deposition step, so this limitation appears unmet.
- Claim 1 (and dependent claims) specify a multi-step process of alternating cationic/anionic polymer treatments culminating in cationic-layer heparin conjugation; the invention instead uses a single

dip-coating step in a heparin-functionalized solution followed by UV curing, which does not correspond to the claimed stepwise polyelectrolyte layering process.

- The claims require the anionic polymer to be dextran sulfate specifically; the invention's coating chemistry (polyurethane surface with covalently bonded heparin) does not mention dextran sulfate or any anionic/cationic polymer layer at all.

Note: The patent claims a specific layer-by-layer polyelectrolyte (cationic/anionic) coating process/product with dextran sulfate as the defined anionic polymer and heparin covalently bound to the outer cationic layer, under specified salt-concentration and molecular-weight/sulfur-content parameters. The invention shares the general theme of covalently bound heparin for anti-thrombogenic effect, which creates some conceptual overlap, but the invention's disclosed structure (polyurethane substrate, direct dip-coating, UV curing) does not appear to include the claimed layered cationic/anionic polymer buildup, dextran sulfate anionic layer, or salt-concentration-controlled deposition steps that the claims require as core limitations. This is an informational screening assessment only, not a legal or infringement conclusion.

4. Observations (small-sample impressions)

> ⚠ **AI REASONING — MAY BE WRONG.** Impressions from this small sample only — not a landscape analysis.

- Crowded: Covalently bonded heparin coatings on medical devices appear frequently in this sample, including multiple entries from BioInteractions Ltd, Boston Scientific Scimed Inc/Lifeshield Sciences LLC, and Carmeda AB (with related family members across HK and ES filings), suggesting this is a well-populated area.
- Crowded: Anti-thrombogenic (often combined with anti-microbial or lubricious) coatings for catheters and related devices are represented by several entries from Teleflex, Arrow International, and Abbott Cardiovascular Systems, indicating active prior art in this general functional space.
- Crowded: General immobilization of biological/anti-thrombogenic agents onto medical device coatings (not specific to catheters) is covered by multiple entries, e.g., Abbott Cardiovascular Systems Inc and Carmeda AB families.
- Open: None of the reviewed patents explicitly combine a catheter shaft substrate, dip-coating application, and a UV curing fixation step together with covalent heparin bonding — this specific combination does not appear directly represented in the sample.
- Open: UV curing as a fixation step for coatings appears in only one reviewed entry (CN114845746A) and is not paired with heparin or dip-coating in this sample, suggesting this combination may be comparatively open.
- Open: Dip-coating as a specifically named application method is not prominently featured across the reviewed sample, which may indicate an underexplored angle relative to other coating techniques (e.g., plasma, grafting, spray) that appear more often.
- This summary reflects impressions from the specific reviewed patent list only and should not be treated as a comprehensive or definitive freedom-to-operate analysis.
- Several entries in the list are expired or abandoned (e.g., US8263170B2, US9127091B2, USRE45500E1, US6306165B1), which may reduce their practical blocking effect but still represent relevant technical disclosures.
- A prior art search focused specifically on the intersection of dip-coating methods and UV-curing fixation for covalent heparin immobilization on catheter shafts is recommended to confirm the observations above.

5. Verification Log

Every deep-reviewed patent below was live-fetched from Google Patents structured data at generation time — patent number, title, assignee, dates, claims text and legal status all come from that fetch, not from AI memory, and the engine never estimates dates. Flagged-but-not-reviewed and claims-unavailable

entries originate from the real search index (existence shown by the search hit itself); their claims were not analyzed.

Hard-fact ledger: 40 deep-reviewed patents live-fetched & verified at generation time · 40 further hits listed from the search index (existence only, claims not analyzed). Relevance grades, overlap/distinguishing points and observations are AI reasoning over the fetched texts and may be wrong.

Cited fact	Status	Verify
US8263170B2	VERIFIED	open source ↗
US20250325733A1	VERIFIED	open source ↗
US20140272232A1	VERIFIED	open source ↗
US9127091B2	VERIFIED	open source ↗
US11850331B2	VERIFIED	open source ↗
US8308699B2	VERIFIED	open source ↗
USRE45500E1	VERIFIED	open source ↗
US10266620B2	VERIFIED	open source ↗
US20220218879A1	VERIFIED	open source ↗
US6338904B1	VERIFIED	open source ↗
US20200316268A1	VERIFIED	open source ↗
US6306176B1	VERIFIED	open source ↗
US10016532B2	VERIFIED	open source ↗
US20230099559A1	VERIFIED	open source ↗
US20250186758A1	VERIFIED	open source ↗
US6372283B1	VERIFIED	open source ↗
US6306165B1	VERIFIED	open source ↗
US20120148852A1	VERIFIED	open source ↗
US20080215138A1	VERIFIED	open source ↗
US20210378678A1	VERIFIED	open source ↗
US7807750B2	VERIFIED	open source ↗
US20130123664A1	VERIFIED	open source ↗
US6309660B1	VERIFIED	open source ↗
US6340465B1	VERIFIED	open source ↗
US20240226395A1	VERIFIED	open source ↗
US8057535B2	VERIFIED	open source ↗
US8403896B2	VERIFIED	open source ↗

US8846836B2	**VERIFIED**	open source ↗
US8927048B2	**VERIFIED**	open source ↗
US10016533B2	**VERIFIED**	open source ↗
CN112316218B	**VERIFIED**	open source ↗
EP3860669B1	**VERIFIED**	open source ↗
CN114845746A	**VERIFIED**	open source ↗
CN114432504B	**VERIFIED**	open source ↗
HK40046542B	**VERIFIED**	open source ↗
HK40046542A	**VERIFIED**	open source ↗
CN103596603A	**VERIFIED**	open source ↗
CN120168732A	**VERIFIED**	open source ↗
EP3332817B1	**VERIFIED**	open source ↗
ES2953184T3	**VERIFIED**	open source ↗

6. Automated QC & Audit Log

QC battery (qc-battery v1.2): PASSED — 11/11 machine checks.

Check	Result	Detail
features_min3	**PASS**	features=5
search_log_nonempty	**PASS**	queries=6
patents_in_search_set	**PASS**	every reviewed patent ⊆ search set
funnel_accounting	**PASS**	flagged=80 = deep=40 + claims_unavailable=20 + listed=20
stats_consistent	**PASS**	stats.deep=40 vs reviewed=40
deep_means_claims_reviewed	**PASS**	every deep-reviewed patent has actual claims text (no unfetched padding in the deep count)
nonzero_review	**PASS**	zero-review report is not deliverable
direction_rule_scan	**PASS**	wrong-direction distinguishing points in final report=0 required; gate removed 5 upstream
legal_status_coverage	**PASS**	structured legal status on 38/40 fetched patents (≥70% required — below that means the status parser broke)
verification_ran	**PASS**	verification ledger present
disclaimer_present	**PASS**	meta.disclaimer

Adversarial AI audit (claude-sonnet-5): verdict YELLOW — every reviewed patent's analysis was independently re-read against the actual claims text by a separate auditor agent instructed to refute it.

- 32 patent note(s) with minor issues — annotated

7. Legal Notice & Report Status

This report was produced by the Patti FTO Intro Scan engine (fto-intro v1, model claude-sonnet-5) on 2026-07-31T07:37:17.450Z.

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- Hard facts vs AI reasoning — patent numbers, titles, dates and claims text come from public sources (verify via links); relevance and overlap assessments are AI-generated and may be wrong.
- Next step — take this report to a registered patent attorney before any filing, launch or investment decision. When you outgrow us, we'll tell you to hire a specialist firm.