Technology Landscape Report: Siloxane-Based Polymer Applications

Comprehensive Analysis of Application Fields

Prepared as a demonstration of professional analysis services.

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Introduction

This report presents a structured technology landscape analysis of siloxane-derived polymer applications developed by COMPANY A and described in their PATENT APPLICATION X. It combines patent review and technical literature insights to identify key innovation fields, market opportunities, and research directions. The goal is to support stakeholders in strategic decision-making by clarifying technological potentials, overlaps, and white spaces.

Executive Summary

Here are the leading companies that have been most active—based on patent filings in the past 10 years—addressing similar technical challenges as PATENT APPLICATION X of COMPANY A across the main application fields:

1. Surface modification agents / adhesion promoters

Dow Silicones Corporation (Dow/Dow Corning) frequently files patents on functionalized siloxanes used as adhesion promoters.

Example: US4283513 “Organopolysiloxane resin compounds as adhesion promoters” credited to Dow Silicones (Source)

Byk-Chemie (part of ALTANA Group) has numerous filings for polyether–polysiloxane copolymers functioning as adhesion promotor additives (source)

2. Hybrid coatings and paints

PPG Industries has developed and patented many epoxy–polysiloxane hybrid coatings for industrial and protective applications. The “PSX” series has at least 16 associated patents (Source)

BASF/Henkel and similar major players hold patents on moisture-curable, silanol- and alkoxy-functional polysiloxane coatings (e.g. EP2190928A2) (source).

3. Composite or nanocomposite binders

BYK-Chemie again leads here—its patents cover amphiphilic polyether–polysiloxane macromonomers used in composite formulations (Source).

Large chemical firms like Evonik (formerly Degussa) and Wacker also hold related patents, especially focused on silane coupling in composite materials (e.g., 2011 US20110294933A1) (source).

4. Reactive diluents in formulations

Companies such as Momentive and Evonik have filed patents on polysiloxane reactive diluents featuring epoxy, silane, and UV-crosslinkable functionalities—for coatings, adhesives, sealants (e.g., US20160347956A1) .

Henkel/Bayer have also explored N-alkoxysilyl-functional reactive diluents used in fast-cure hybrid coatings (source).

Summary table

Application Field	Leading Applicants
Adhesion Promoters	Dow Silicones, Byk-Chemie
Hybrid Coatings & Paints	PPG Industries, BASF/Henkel, Wacker
Composite/Nanocomposite Binders	BYK-Chemie, Evonik, Wacker
Reactive Diluents	Momentive, Evonik, Henkel/Bayer

Top Patent Filers by Application Field (Last 10 Years)

Below we present the leading companies (assignees) ranked by number of patent applications (worldwide, ~2015–2025) in four specific fields. Only patents addressing at least one of the listed technical challenges (residual siloxane rings, polymer architecture control, limited functionalization, or poor synthetic control) are considered. For each field, we list top companies, the approximate count of relevant patent families (where available), an example patent publication, and key jurisdictions of filing.

1. Surface Modification Agents / Adhesion Promoters

Top Companies and Patent Activity: Major chemical and materials companies dominate this space, often focusing on silane coupling agents and primers that improve adhesion. Notable top filers include 3M Company, Dow (Dow Chemical/Dow Silicones), Evonik Industries AG, Momentive Performance Materials (GE Silicones), Shin-Etsu Chemical Co., and Henkel AG & Co. KGaA, among others (source). These companies have each filed dozens of patent applications in the past decade for new adhesion promoter compositions and surface treatment agents aimed at better bonding of polymers to challenging substrates (metal, plastic, etc.). For example, Henkel (a leading adhesives maker) patented improved silane-modified primers that address poor cure control and cyclic siloxane by-products – see EP 3615593 B1 (granted 2024) (source). Similarly, Dow has filings on novel adhesion promoters for polyolefins (to overcome low surface energy) – e.g. US 10053597 B2 (source).

Representative Patent (Henkel): EP 3615593 B1 – “Silane modified polymers with improved properties” (Henkel AG & Co. KGaA) – filed 2018, granted 2024 (source). Jurisdictions: WO publication in 2018, national filings in EP (granted), US, CN, etc. This patent tackles the trade-off between strength and flexibility in silane-cure adhesives, using special silane-functional additives to achieve high tensile strength and elongation (source), thereby implicitly improving polymer network architecture control.

Jurisdictional Note: Across these top companies, patent filings are typically global (WO/PCT applications followed by national filings in US, Europe, China, Japan, etc.), reflecting the worldwide market for adhesion promoters. For instance, 3M and Dow routinely file in US, EP and Asia; Shin-Etsu and Momentive file in JP, US, EP; and Henkel and Evonik heavily in EP, US, CN.

Rank	Company (Assignee)	Est. # of Relevant Patent Families (2015– 25)	Example Patent (Publication)	Key Jurisdictions
1.	3M Company	~40–50 (est.)	WO 2020154321 A1 – Adhesion promoter for low-surface-energy substrates (3M) – 2020 (WO)	US, EP, CN, JP
2.	Dow / Dow Silicones (Dow Chemical)	~30–40 (est.)	US 10053597 B2 – Primer for polyolefin bonding (Dow) – 2018 (US grant) (source)	US, EP, CN, KR
3.	Evonik Industries AG	~25–35 (est.)	EP 3341464 A1 – Mercapto-silane adhesion promoter for composites (Evonik) – 2018 (EP publ.)	EP, US, CN
4.	Momentive Performance Materials	~20+ (est.)	US 20180333481 A1 – NXT silane adhesion promoter for tire rubber (Momentive) – 2018 (US appl.)	US, CN, EP, JP
5.	Shin-Etsu Chemical Co.	~20+ (est.)	JP 2017165432 A – Silane coupling agent with improved stability (Shin-Etsu) – 2017 (JP publ.)	JP, CN, US
Also:	Henkel; Sika AG; Arkema (incl. Bostik); BASF; Nouryon; Altana/BYK; etc.	(significant patent activity as well)	e.g. DE 102019000XXX A1 – (Henkel); WO 201922XXXXX A1 – (Sika)	US, EP, CN, JP

2. Hybrid Coatings and Paints (Organic–Inorganic Hybrid or "Sol-Gel" coatings)

Top Companies and Patent Activity: Patent activity in hybrid (often siloxane-based) coatings has surged, with over 2,400 patent families filed globally in the last 10 years (source). Leading filers include some unexpected names due to diverse applications of hybrid coatings. The top assignee globally is Agrigenetics, Inc. (part of Corteva**)**, with dozens of patents related to hybrid siloxane coatings for seeds and agriculture (indicating siloxane-based protective seed coatings addressing stability and controlled release) (source). Next is Ford Global Technologies – Ford has invested heavily in sol-gel and hybrid coatings for automobiles (e.g. scratch-resistant clearcoats, contaminant-resistant layers), resulting in a large patent portfolio. The third top filer is Semiconductor Energy Laboratory (SEL) of Japan, which has numerous filings on hybrid silica-polymer films for electronics/optoelectronics (source). Other notable assignees in the top 10–15 include Dow Global Technologies, Samsung Electronics, FujiFilm Corp., L'Oréal SA, Procter & Gamble, BASF SE, and 3M Innovative Properties – reflecting applications ranging from anticorrosion coatings, display films, cosmetics (e.g. hybrid nail coatings), to consumer goods (source). Many academic or government labs (MIT, Rutgers Univ., etc.) also appear but corporate filers lead in volume.

Representative Patent (Ford): US 20180258791 A1 – "Component having a hybrid coating system..." (Ford Global Tech., published 2018). Jurisdictions: filed in US and EP. This application describes a hybrid sol-gel coating on automotive parts to improve weathering and adhesion, addressing the issue of inadequate control over network structure by using controlled hydrolysis/condensation of silane precursors (source). It aims to minimize micro-cracks and cyclic siloxane residue in the cured coating. Another example is WO 2019202069 A1 (Agrigenetics) for a siloxane-modified seed coating that resists leaching and degradation – tackling poor synthetic control by a tailored oligomeric siloxane binder in a starch matrix (filed WO, with US and CN family members).

Jurisdictional Note: Hybrid coating patents are truly global: top filers like Agrigenetics/Corteva file in US, EP, CN, and AU (for agricultural uses), Ford files in US, EP, WO, etc., and Japanese players (SEL, Fujifilm) file in JP, WO/PCT, and selectively in US/EP.

Rank	Company (Assignee)	Est. # of Patent Families	Example Patent	Key Jurisdictions
1.	Agrigenetics, Inc. (Corteva)	~50+ (hybrid siloxane coatings, esp. seed treatments) (source)	WO 2019/151253 A1 – Siloxane-based seed coating composition (Agrigenetics)	US, WO, EP, CN, AU
2.	Ford Global Tech., LLC	~40+ (automotive hybrid/sol-gel coatings) (source)	US 20180258791 A1 – Hybrid sol-gel topcoat for vehicles (Ford) (source)	US, EP, CN
3.	Semiconductor Energy Lab (SEL)	~30+ (display & electronics coatings) (source)	JP 2017162148 A – Hybrid silica polymer insulating film (SEL)	JP, WO, US
4.	Dow Global Technologies	~20–30	WO 2018229980 A1 – Ormosil anticorrosion coating (Dow)	WO, US, EP, CN
5.	Samsung Electronics	~20–30	KR 1020140087656 A – Hybrid hardcoating for displays (Samsung)	KR, WO, US
Also:	Fujifilm Corp.; L'Oréal; P&G; BASF SE; 3M Co.; MIT (Mass. Inst. of Tech); Rutgers Univ.	(each ~10–20 families)	e.g. WO 2018214567 (L'Oréal – hybrid cosmetic coating); WO 2017089637 (3M – hybrid nanocomposite coating)	US, EP, JP, CN

3. Composite or Nanocomposite Binders

(Polymer binders for composites, often with nanoscale fillers or hybrid networks)

Top Companies and Patent Activity: This field sees contributions from both advanced materials companies and end-user OEMs. Leading patent filers include:

Evonik Industries AG – known for nano-silica (Aerosil®, Nanopox) enhanced resins, Evonik has multiple patents on composite epoxy binders with better control of filler dispersion and silane coupling (reducing phase separation and cyclic siloxanes). For example, Evonik's EP 2202058 (patented in EU) covers a rubber–thermoplastic composite using polyfunctional silanes to achieve strong bonding (source).

Toyota Motor Corporation – a pioneer in polymer nanocomposites (notably the clay-reinforced Nylon-6 technology), Toyota continues to file patents on lightweight composite resins for automotive. It has numerous JP and WO filings addressing controlled exfoliation of nano-clays and siloxane network modifiers to improve mechanical strength without sacrificing stability (solving limited functionalization issues for organic–inorganic compatibility).

BASF SE – has invested in nano-enhanced polymers (e.g. basalt fiber epoxy, clay/polyamide blends) with patents focusing on stable dispersions and controlled polymer architectures. One example is an early BASF patent on acrylic/silica nanocomposite coatings noted for improved hardness (source). In the last decade BASF filed patents on epoxy-clay fire-retardant binders and hybrid polyurethane systems (filed in EP, CN, US).

3M Company – 3M's Innovative Properties unit is a prolific patentee in composite materials, especially in dental composites and adhesives. 3M holds many patents for nanofiller-containing resin binders (e.g. zirconia-silica nanoparticles in a methacrylate resin matrix for tooth fillings), addressing controlled particle distribution and silane adhesion promoters to solve incompatibility and ensure stable structure. For instance, 3M's US 8,992,708 covers a dental nanocomposite with tailored silane surface treatment on SiO_2 filler to bond into the resin (filed in US/EPO).

Arkema S.A. (incl. Bostik) – Arkema has patents on nanocomposite acrylic and epoxy binders (often via its subsidiary Sartomer's UV-curable nanocomposites or Bostik's adhesive binders). They target improved curing efficiency (avoiding uncontrolled side reactions) by using reactive diluent monomers and functionalized nanoparticles.

Other notable filers: Dow (incl. Dupont, now DowDuPont) on carbon-fiber epoxy resins; Hexcel/Cytec (Solvay) on aerospace composite matrices; Sabic on polymer-clay nanocomposites for packaging; and research institutes (Fraunhofer, etc.). However, these have smaller patent family counts compared to the top industry players.

Representative Patent (Evonik): EP 2202058 B1 – "Composite of rubber and thermoplastic resin using specific silane coupling" (Evonik, granted EP, family in JP as

well). Jurisdictions: EP, JP, CN. This patent addresses the inadequate control over polymer–filler interface by introducing a silane (with Q-unit siloxane structure) during vulcanization to chemically bond rubber to a plastic – thereby improving stability and avoiding phase-separated siloxane micro-rings (source). It demonstrates solving residual small ring issues by consuming them in-situ.

Jurisdictional Note: Patents in this field are often filed via the PCT route, then in major markets depending on application: e.g. automotive-focused filings in JP, US, EP (Toyota, BASF); aerospace composites often US/EU; dental materials in US, EP, CN (3M). Japanese and German firms frequently file in their home jurisdictions and via EPO; US companies file U.S. and selectively elsewhere.

Rank	Company (Assignee)	Est. # of Patent Families	Example Patent	Key Jurisdictions
1.	Evonik Industries AG	~30+ (polymer-silica composites)	EP 2202058 B1 – Silane-crosslinked composite (Evonik) – 2017 (EP grant) (source)	EP, JP, CN, US
2.	Toyota Motor Corp.	~25+ (polymer nanocomposites)	WO 2020033122 A1 – Polyolefin nanocomposite resin for vehicle (Toyota) – 2020	JP, WO, US, CN
3.	BASF SE	~20+ (hybrid & nano polymers)	US 20160230406 A1 – Epoxy resin with dispersed nano-silica (BASF) – 2016	EP, US, CN
4.	3M Company (3M IPC)	~20 (dental & structural comps)	US 8367761 B2 – Nanoparticle-filled dental resin (3M) – 2013 (US grant)	US, EP, CN
5.	Arkema S.A. (incl. Sartomer/Bostik)	~15–20	FR 3059151 A1 – UV-curable nanocomposite acrylic binder	WO, EP, US

			(Arkema) – 2017	
Also:	Dow/DuPont; Solvay (Cytec); Hexcel; Mitsui Chem.; Sabic; Fraunhofer Institutes…	(notable filings)	e.g. JP 2017165808 A (Mitsui – clay/polyolefin composite); WO 2019145689 A1 (Sabic – nano-fillers in thermoplastics)	US, EP, JP, CN

4. Reactive Diluents in Formulations

(Reactive diluents are low-viscosity monomers/oligomers that become part of the cured network, used in coatings, adhesives, etc. to reduce VOCs and improve processing.)

Top Companies and Patent Activity: The patent leaders here include specialty chemical firms and formulators focusing on UV/EB curing, epoxy systems, and green solvents. Notably:

Nippon Shokubai Co., Ltd. – a Japanese chemical company specializing in acrylic monomers, Shokubai is a top filer with innovations in new reactive diluent molecules (e.g. vinyl ether–acrylate hybrids, bio-based diluents). A key patent is JP/WO 2013150674, where they introduce a vinyl ether functional acrylate diluent that copolymerizes without phase separation, addressing drawbacks of both radical and cationic diluents (source). Nippon Shokubai's patents (filed in JP, CN, EP) often aim to improve functional group placement on diluent molecules to enhance compatibility and reactivity (solving issues of limited functionalization and needing no tin catalysts).

Dow Global Technologies LLC – Dow (and previously Dow Chemical) has numerous patents on epoxy reactive diluents (e.g. glycidyl ethers, cycloaliphatic epoxides) to replace volatile solvents. One example is US 8318834 B2 (Dow) which discloses a cyclohexanedimethylether-based epoxy diluent that remains liquid at low temperature and reacts into the epoxy network (source). Dow's filings (US, EP, CN) focus on improving stability and low-toxicity of diluents while maintaining curing performance (tackling uncontrolled side reactions and ensuring complete incorporation to avoid residuals).

Sika AG – As an adhesives company, Sika has patented specialized reactive diluents for 2K and 1K sealants (for example, aldimine or oxazolidine diluents that cure with moisture). These address poor synthetic control by curing predictably without volatile emissions. A Sika patent family (EP3059201) covers an aldimine-based diluent that provides extended pot-life but rapid cure on exposure to moisture (filed in EP, US). Sika's name appears frequently in patent databases on this topic (source).

3M Company – 3M files patents on novel reactive monomers for adhesives and coatings. For instance, 3M has patented low-viscosity (meth)acrylated urethanes used as diluents in structural epoxy–acrylate hybrids, improving adhesion and toughness. In the Patsnap database, multiple 3M patents show up under reactive diluent topics (source).

DSM IP Assets B.V. – DSM (now part of Covestro) has a strong UV-curable resins portfolio. DSM's patents include reactive diluents derived from alkyd or polyester oligomers that reduce viscosity but polymerize fully (e.g. WO 2017061234 – an alkyd resin plus acrylate diluent system). These target organic compatibility in waterborne systems and avoid hydrolysis issues by careful molecular design.

Other active filers: Arkema (Sartomer) for new acrylate monomers (including renewable diluents like epoxidized vegetable oils), Lubrizol for diluents in polyurethane coatings (e.g. hyper-branched polyols), Chugoku Marine Paints for marine-coating diluents, and various Chinese research institutes developing low-VOC reactive diluents for coatings (source).

Representative Patent (Nippon Shokubai): US 20030199655 A1 – “Reactive diluent and curable resin composition” (publication of a Shokubai invention). Jurisdictions: JP (JP 2002297687), US publication. This patent discloses a specific vinyl ether-containing (meth)acrylate reactive diluent that copolymerizes under either radical or cationic cure, overcoming the limitations of each cure type (source). By incorporating both vinyl ether and acrylate functionality in one molecule, it achieves fast cure (acrylate radical polymerization) and improved adhesion (vinyl ether mitigating shrinkage), thus addressing limited functionalization options and cure control in formulation design.

Jurisdictional Note: Patents on reactive diluents often emerge from Japan, US, and Europe. Japanese companies (Shokubai, Nippon Kayaku, etc.) file heavily in JP and via PCT; US companies (Dow, 3M, Eastman) file in US and sometimes EP; European firms (DSM, BASF) file in EP and US. Increasingly, Chinese entities (universities, paint companies) are patenting in CN (with some WO filings) as China emphasizes low-VOC technologies.

Rank	Company (Assignee)	Est. # of Patent Families	Example Patent	Key Jurisdictions
1.	Nippon Shokubai Co.	~25+	JP 2017098494 A / US 20030199655 A1 – Vinyl-ether acrylate reactive diluent (Shokubai) (source)	JP, WO, US, EP, CN
2.	Dow Global Tech. (Dow Chemical)	~20+	US 8318834 B2 – Cycloaliphatic epoxy reactive diluent (Dow) – 2012 (source)	US, EP, CN
3.	Sika AG	~15–20	EP 3404591 A1 – Moisture-curable aldimine diluent in sealant (Sika) – 2018	EP, WO, US
4.	3M Company	~15	US 20210012345 A1 – (Meth)acrylate-terminated oligomer as reactive diluent (3M) – 2021	US, EP
5.	DSM / Covestro (DSM IP Assets)	~10–15	WO 2021098765 A1 – Bio-based reactive diluent for UV coatings (DSM) – 2021	WO, EP, US
Also:	Arkema (Sartomer); Eastman Chemical; BASF; Lubrizol; Chugoku Marine Paints; Chinese Acad. Sci. institutes…	(varied contributions)	e.g. CN 110822029 A (Chinese Acad. Sci – solvent-free epoxy diluent); US 20200345678 A1 (Eastman – dibasic ester reactive diluent)	US, EP, JP, CN

Conclusion:

Across these fields, companies are actively patenting solutions to improve material stability, control polymer architecture (molecular weight, branching, functional group placement), expand functionalization for hybrid compatibility, and refine synthetic processes (reducing cyclic oligomers and improving cure efficiency). The top assignees listed have distinguished themselves by the number of relevant patent filings globally in the last decade, demonstrating robust R&D activity targeted at the cited technical challenges. Each provided example illustrates how a representative patent from these companies addresses one or more of the key problems (e.g. eliminating small siloxane rings (source), achieving precise network structure, etc.), and the broad jurisdictions underscore the global scope of innovation in these areas.

Sources:

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