

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

JIANGSU FAVORED NANOTECHNOLOGY CO., LTD.,

Petitioner,

v.

P2I LTD.,

Patent Owner.

CASE: IPR2024-00380

Patent No. 11,041,087

**DECLARATION OF DR. KAREN GLEASON
IN SUPPORT OF PETITION FOR INTER PARTES REVIEW**

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I. INTRODUCTION

1. My name is Dr. Karen K. Gleason.

2. I have been engaged by Petitioner Jiangsu Favored Nanotechnology Co., Ltd. to investigate and opine on issues relating to claims 1-5, 7 and 9-14 of U.S. Patent 11,041,087 (Ex. 1001), which I will refer to here as the '087 patent, in connection with Favored's petition for *inter partes* review of the '087 patent.

3. In this declaration, I will first discuss the technical background relating to the '087 patent, and then I will provide my analyses and opinions relating to certain claims of the '087 patent.

4. This declaration is based on the information currently available to me. To the extent that additional information becomes available, I reserve the right to continue my investigation and study, which may include reviewing documents and information that may be produced, as well as testimony from depositions that may be taken.

II. QUALIFICATIONS AND EXPERIENCE

A. Education and Professional Experience

5. Ex. 1003 is a copy of my curriculum vitae (CV), which provides listings of my educational background, professional experience, and scientific publications that are relevant to the subject matter of this proceeding. I possess the knowledge, skills, experience, training, and education to form an expert opinion and provide expert testimony in this matter.

6. I have 36 years of experience in the field of chemical engineering, with the last 27 years having a specific focus on polymer chemistry and production of polymer coatings.

Education

7. I received bachelor of science (S.B.) and master of science (S.M.) degrees in Chemical Engineering from the Massachusetts Institute of Technology (M.I.T.) in 1982. I also received All-American honors in swimming while a student at M.I.T. I received a Ph.D. in Chemical Engineering from the University of California, Berkeley, in 1987. My doctoral thesis identified the molecular structure of defects in thin films used in the fabrication of solar cells. These thin films were produced by Chemical Vapor Deposition (CVD).

Professional Career

8. I have been employed as a professor of chemical engineering at M.I.T. since 1987. I was an assistant professor from 1987-1993, an associate professor from 1993-2000, a full professor from 2000 to 2020, and a professor emerita from 2020 to the present. I held the Herman P. Meissner Career Development Professorship in Chemical Engineering from 1987-1990 and the Esther and Harold E. Edgerton Career Development Professorship from 1991-1995. From 2006 to January 2020, I was the Alexander and I. Michael Kasser Professor of Chemical Engineering. Since

January 2020, I have assumed the title of Alexander and I. Michael Kasser Professor of Chemical Engineering, Emerita.

9. I have served in additional roles at M.I.T. during my time as a professor. I was the Executive Officer (vice chair) of the Department of Chemical Engineering from 2001-2004, the Associate Director of the Institute for Soldier Nanotechnology from 2005-2008, the Associate Dean of Engineering for Research from 2008-2011, and the Associate Provost for Space Planning and Industrial Relationships from 2014-2018.

10. I am a member of the National Academy of Engineering and a fellow of the American Institute of Chemical Engineering.

11. I am also a co-founder of GVD Corporation, which was founded in 2001. From 2001 to 2020, I was the Chief Scientific Advisor for GVD. From 2006 to 2020, GVD manufactured CVD polymer release coatings used in the molding of rubber tires for vehicles and for seal and gasket applications.

12. The focus of my work in the most recent 27 years of my professional career has been on elucidating the mechanisms of CVD polymer growth and inventing new methods of CVD polymerization. For this research, my laboratory built more than a dozen custom CVD reactors. My group published on both continuous wave and pulsed plasma polymerization, also known as plasma enhanced CVD (PECVD). The applications explored ranged from low dielectric constant layers for

microelectric circuits to biopassive coatings for implantable medical devices. By adding an initiator species to the reactive gas inlet, the power required for plasma polymerization is greatly reduced, a method we named iPECVD. We demonstrated that thin iPECVD layers can serve as membranes for separating individual gases from a mixture of gases. By understanding the mechanisms of plasma polymerization, two new polymer CVD methods were developed: initiated CVD (iCVD) and oxidative CVD (oCVD). Using iCVD and oCVD, dozens of different monomers have been polymerized. In 2018, oCVD achieved the record for the highest electrical conductivity (>6000 S/cm) of the polymer polyethylene dioxythiophene (PEDOT), a material of great interest for fabricating flexible electronic devices.

Scientific Publications

13. I have authored more than 300 scientific publications in the fields of chemical engineering and polymer chemistry. I am the sole editor of the book *CVD Polymers Fabrication of Organic Surfaces and Devices*, first published by Wiley in 2015. I am a named inventor of more than 40 issued U.S. patents. I have also spoken about my work at numerous scientific conferences and symposia. My accompanying CV includes listings of my publications, professional speaking engagements, and patents. Ex. 1003.

B. Compensation

14. I am being compensated \$515/hour and reasonable expenses, which is my standard consulting rate, for the services I am providing under my engagement with Jiangsu Favored Nanotechnology Co., Ltd., including the preparation of this declaration. That compensation is not contingent upon my performance, the outcome of this *inter partes* review or any other proceeding, or any issues involved in or related to this *inter partes* review or any other proceeding.

C. Documents and other materials relied upon

15. In forming my opinions, I have relied on information and evidence identified in this declaration, including the '087 patent, its prosecution history, and other references listed as exhibits in Favored's *inter partes* review petition or cited herein.

III. STATEMENT OF LEGAL PRINCIPLES

A. Legal standards for obviousness

16. I understand that where a single prior art reference does not disclose all of the elements of a given patent claim, that patent claim is invalid if the differences between the claimed subject matter and the prior art reference are such that the claimed subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the relevant art. Obviousness can be based on a combination of references that together disclose all elements of the claimed invention either expressly or inherently.

17. I further understand that, in determining whether a patent claim was obvious, one can consider whether there would have been any teaching, suggestion or motivation to combine the teachings of two or more prior art references that, together, contain all of the elements of the patent claim, and whether a person of ordinary skill in the art would have had a reasonable expectation of success in doing so. In other words, one can consider whether the combined prior art, taken as a whole, would have rendered the claimed invention obvious to one of ordinary skill in the art at the time of the invention. I further understand that to determine whether an invention would have been obvious at the time it was made, the Board will look to four factors: (1) the scope and content of the prior art; (2) the differences between the prior art and the claimed invention; (3) the level of skill in the pertinent art; and (4) any secondary considerations of non-obviousness.

18. I understand that secondary considerations that may indicate non-obviousness can include: (1) whether there was a long-felt need for the claimed invention; (2) whether the claimed invention has achieved commercial success; (3) whether there was copying of the claimed invention by others; (4) whether there were failed attempts by others to make the claimed invention; (5) whether there was praise of the claimed invention in the field; (6) unexpected results of the claimed invention; and (7) whether there was skepticism in the field whether the claimed invention could be achieved. For secondary considerations to be accorded substantial weight,

I understand that there must be a nexus between the secondary considerations and the claimed invention. For example, if a secondary consideration results from something other than what is claimed and novel, then there is no nexus. In addition, I understand that another potential factor of that can suggest that a claimed invention *was* obvious is the independent simultaneous invention by others.

19. To determine whether there was motivation to modify or combine prior art references to obtain the claimed invention, I am informed that such motivation may come from the nature of the problem to be solved, which would lead inventors to look to certain references for possible solutions to that problem. In other words, the test may be said to be whether a person of ordinary skill in the art would have reasonably expected to use the solution that is claimed in the patent, if the person were seeking to solve the problem addressed by the patent and that person had the prior art before them at the time. Motivation to modify references may be found in the references themselves, as well as in the general knowledge of persons skilled in the art.

20. I also understand that a claim can be determined obvious if the claimed combination would have resulted from common sense, would have been obvious to try (such as being one of a relatively small number of possible approaches to the problem that would have been reasonably expected to succeed), or would have been the predictable result of using prior art elements according to their known functions.

I also understand that obviousness can take into account the inferences and creative steps that a person of ordinary skill in the art would employ.

B. Claim construction

21. I understand from counsel that a claim term in an unexpired patent must be given its ordinary meaning as understood by a person of ordinary skill in the art in the same field as the patent when considered in context of the patent's claims, specification, and prosecution history. In some cases, the inventor may use terms in a manner other than in their ordinary meaning by clearly, deliberately, and precisely stating that special definition in the patent specification or in the file history. I further understand that, under the legal principle of claim differentiation, two different claims in the same patent (and in particular, an independent claim and one of its dependent claims) should not be interpreted in a way that would render them identical in scope, if that result can be avoided.

IV. LEVEL OF ORDINARY SKILL IN THE ART

22. I understand from counsel that the claims and specification of a patent must be read and construed through the eyes of a person of ordinary skill in the art (POSA) at the time of the patent's priority date. To determine the appropriate qualifications of a POSA, I understand that the following factors may be considered:

(a) the types of problems encountered by those working in the field and prior art

solutions to such problems; (b) the sophistication of the technology in question; and (c) the typical level of training for active workers in the field.

23. I understand from counsel that I should assume for purposes of my analysis that the priority date for the '087 patent was June 9, 2015.

24. The '087 patent describes protective coatings applied to a variety of electronic devices and electronic components. Ex. 1001 at 1:14-22, 14:38-65. The patent indicates that the coatings can repel liquids such as water or can provide an electrically insulating barrier layer. Ex. 1001 at 1:17-22, 2:64-3:15.

25. The coatings are applied using plasma polymerization with a plasma containing two main components: a monomer and a crosslinker. Ex. 1001 at Abstract, 2:19-29, 2:57-63, 4:39-13:17. For the monomer, the '087 patent describes many different organic compounds containing a double bond, including acrylates and methacrylates. Ex. 1001 at 2:28-56, 9:25-13:15. By 2015, such monomers had been used to create hydrophobic coatings through plasma polymerization for many years, as the '087 patent acknowledges. Ex. 1001 at 1:26-28 (citing Ex. 1022, published in 1998); Ex. 1022 at 7:21-31 (describing plasma polymerization of fluoroacrylates to give hydrophobic polymers).

26. According to the specification, combining the monomer with a crosslinker during plasma polymerization produces crosslinked co-polymer coatings that retain the monomer structure for good hydrophobicity while providing stability due

to the crosslinked structure of the coatings. Ex. 1001 at 2:57-3:1, 14:26-36. At the time of the '087 patent's priority date in June 2015, POSAs were familiar with the use of crosslinking reagents in free-radical polymerization, including coatings prepared using many of the same preferred monomers and crosslinkers described in the '087 patent. Ex. 1010 4:1-9, 4:26-29, 9:10-16; Ex. 1004 at 3:51-62; Ex. 1014 ¶ 52; Ex. 1006 at 610; Ex. 1026 at 6553; Ex. 1001 at 8:1-13 (crosslinkers), 9:25-50 (monomers); Ex. 1039 at 28 (plasma polymerization of DVTMDS).

27. As the '087 patent indicates, plasma polymerization was well known to POSAs by June 2015, and POSAs could perform plasma deposition using existing equipment and routine methods and would have known how to adjust plasma composition and reaction conditions to achieve desired properties in the polymer coating. Ex. 1001 at 14:3-9, 14:26-36, 14:66-15:7, 15:14-16. The plasma deposition equipment and techniques described in the '087 patent would have been considered conventional in the field by June 2015.

28. A worker in the relevant field with an ordinary level of skill at the '087 patent's priority date would have had familiarity with technical principles relating to polymer chemistry and plasma generation and would have had at least some experience operating and adjusting the operating conditions for a plasma polymerization chamber. In my experience, such workers in the field with an ordinary level of

skill at the time typically had at least a bachelor's degree in a relevant discipline and some experience with plasma polymerization.

29. Based on the considerations discussed above, it is my opinion that a POSA at the time of the priority date for the '087 patent would have had at least a bachelor's degree in a field such as chemistry, physics, or chemical engineering, as well as at least two years of experience with plasma-polymerization techniques.

V. SUMMARY OF OPINIONS

30. For the reasons explained below, it is my opinion that certain claims of the '087 patent would have been obvious to a POSA by June 2015. Plasma polymerization was well known and conventional by that time, as was its use for applying protective coatings to electronics. The monomers recited in the claims were known by that priority date, the claimed crosslinking reagents were also known in the field, and the prior art had already specifically described combining the claimed monomers with the claimed crosslinkers to prepare crosslinked polymer coatings. There was nothing innovative about combining known compounds by a known method to apply protective coatings to electronic devices that had long been targets of such treatments. I therefore conclude that the claims would have been obvious to a POSA over the prior art discussed here.

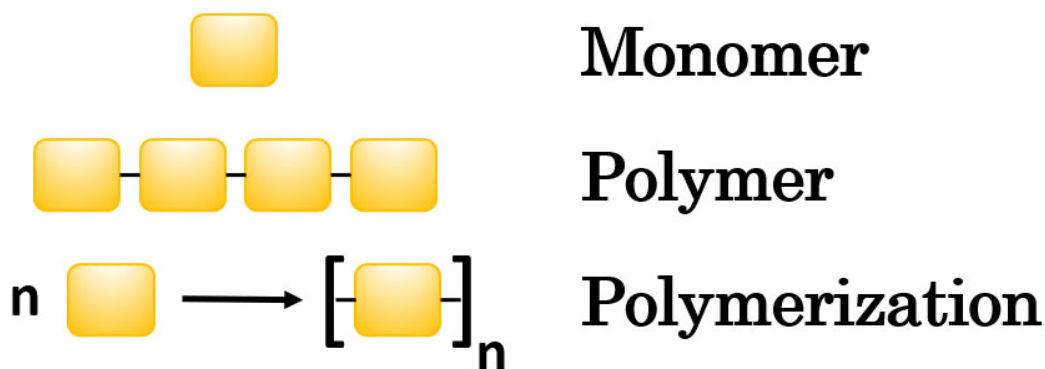
VI. TECHNICAL BACKGROUND

31. The discussion in this section summarizes the relevant technology and the state of the art by June 9, 2015.

A. Polymerization

32. In general, polymers contain repeating structural units derived from small-molecule reactants, known as monomers. Bonds between the monomeric units form extended chains or networks via a process referred to as polymerization.

The simple schematic below captures these concepts:



33. The process of chain polymerization was an important mechanism for forming polymers before 2015, which is described in the 1994 textbook Odian, G., Principles of Polymerization (1994) (Ex. 1036). The monomers used for chain polymerization generally contain one or more unsaturated carbon-carbon bonds. Ex. 1036 at 198-200. Examples of unsaturated bonds are a double bond ($C=C$) or a triple bond ($C\equiv C$). In addition, chain polymerization generally uses an initiator species. One such class of initiators produces free radical species. Free radicals are unpaired

electrons that serve as reactive centers towards the unsaturated bond of the monomer. Free radicals readily react with unsaturated bonds such as a double or triple bond present in a monomer. The reaction product is also a free radical species, so that the reaction product is also capable of reacting with another monomer molecule. Thus, another monomer can be added, and since the reaction product is again a free radical, the cycle can repeat, adding monomer units one at a time. The process of adding one monomer at a time is known as propagation. The propagation reaction cycle can be continued many more times to synthesize the polymer chain. Ex. 1036 at 204-05. Prior to 2015, it was known that many types of unsaturated monomers were well-suited for free radical chain polymerization, including acrylates, methacrylates, and vinyl esters. Ex. 1036 at 200 (Table 3-1, listing various monomers, including acrylates, methacrylates, and vinyl esters).

34. Free radical initiation can cause the polymerization of almost any carbon-carbon double bond. Ex. 1036 at 202. Free radical initiators contain chemical bonds that can cleave to form a reactive free-radical centers. Thermal heating was one way to cause such bonds to cleave. Peroxy compounds contain easily cleaved O-O bonds and were widely used initiators for conventional free radical polymerization. Ex. 1036 at 210; Ex. 1004 at 1:45-62. Azo compounds that release molecular nitrogen, N₂, were another well-known class of free radical initiators. Ex. 1036 at 211.

B. Plasma polymerization

35. Chain polymerization of unsaturated monomers was also recognized to occur under plasma conditions through a similar mechanism initiated by free radicals present in plasma. Ex. 1036 at 227 (discussing plasma polymerization); Ex. 1037 at 31; Ex. 1014 ¶ 39; Ex. 1049 at 1:50-59. Identification of the mechanism allows the many monomers used for polymerization by conventional free-radical methods, such as acrylates and methacrylates, to be predictably and successfully employed for plasma polymerization. Indeed, in 2004, Kurosawa demonstrated plasma polymerization with 12 different acrylate monomers and 12 different methacrylate monomers while maintaining the same plasma reactor conditions. Ex. 1037 at 30-31. Plasma polymerization had also been demonstrated with vinyl esters, Ex. 1041 at 36 (vinyl butanoate and vinyl hexanoate), and with vinyl crosslinkers, Ex. 1046 at 5 (DVTMDS). Skilled artisans had thus observed before 2015 that monomers compatible with conventional free radical chain polymerization were also expected to be useful for plasma polymerization and to result in high deposition rates for plasma-deposited polymer films. Ex. 1037 at 32.

36. By 2015, plasma polymerization was a common technique that had been widely used to deposit thin-film coatings on various substrates for many years. Ex. 1011 at 2:33-3:18; Ex. 1010 at 2:10-20; Ex. 1040 at 1-2; Ex. 1005 at 6:10-11, 21:20-22:2; Ex. 1006 at 606-07; Ex. 1012 at 7:22-8:7; Ex. 1014 at ¶ 11; Ex. 1013 at

¶¶ 45-46; Ex. 1015 at ¶ 29. Plasma polymerization involves forming polymeric materials under plasma, which is a gas in an at least partially ionized state that contains charged molecules or atoms and free electrons. Ex. 1040 at 19. One of the '087 patent's inventors, Stephen Coulson, acknowledged in a 1999 patent application (approximately fifteen years before the '087 patent's priority date) that even by that time plasma polymerization had already been "quite widely used for the deposition of polymeric coatings onto a range of surfaces" and that equipment for applying plasma coatings was "conventional" and "known in the art." Ex. 1010 at 2:10-12, 11:26-27.

37. In general, plasma polymerization involves vaporizing at least one monomer compound that supplies the input material to be polymerized. Ex. 1011 at 2:33-3:18; 7:6-17; Ex. 1012 at 3:5-14, 11:17-13:20; Ex. 1005 at 21:20-22:2. A wide variety of organic compounds had been used as monomers used for plasma polymerization by June 2015. Ex. 1040 at 2-3.

38. The plasma state can be induced in a gas containing monomer vapor through various means, but applying an electromagnetic field was the simplest and most commonly used approach. Ex. 1011 at 3:2-5; Ex. 1010 at 2:14-20; Ex. 1019 at 2032; Ex. 1005 at 21:20-22:2; Ex. 1040 at 19. The excited species in the plasma often give off visible light emanating from at least a portion of the resulting plasma—often referred to in the field as a "glow discharge." Ex. 1011 at 7:14-17;

Ex. 1010 at 10:17-18; Ex. 1017 at 3:26-33; Ex. 1019 at 2032; Ex. 1040 at 19-20. One example of a glow discharge occurs upon illuminating a common neon sign, which applies an electromagnetic field to a gas-filled chamber within such signs to create their familiar luminous appearance.

39. When applying an electromagnetic field to a gas to generate plasma, the electrical power was commonly applied in one of two ways: continuously (known as “continuous wave” plasma generation) or in rapid on/off cycles (known as “pulsed” plasma generation). Ex. 1019 at 2032-33 (Table 2). Pulsed plasma had recognized advantages for many coating applications because it permits application of sufficient electrical power to generate and maintain plasma but subjects the gas-phase monomer to that power for only part of the total polymerization time, thus resulting in less applied power and better preserving the original monomer structure in the resulting plasma polymer coating. Ex. 1019 at 2035-36; Ex. 1023 at 8724.

40. When a plasma generated from a gas-phase monomer comes in contact with a substrate, the species in the plasma impinge on the substrate surface and react to form a polymer film that is deposited as a coating on the substrate. Ex. 1010 at 2:10-24; Ex. 1012 at 13:3-20; Ex. 1005 at 21:20-22:2; Ex. 1018 at 8:17-48. During plasma polymerization, it was very common to supply the gas-phase monomer for plasma polymerization in a mixture with an additional carrier gas, often an inert gas like helium or argon. Ex. 1011 at 7:19-23; Ex. 1021 at ¶ 63; Ex. 1022 at 5:20-22.

41. Plasma polymerization is traditionally carried out in enclosed chambers to contain the gaseous reagents and the associated plasma during operation. Ex. 1005 at 21:20-25; Ex. 1011 at 3:20-4:3, 7:6-17; Ex. 1012 at 11:17-13:20. Plasma chambers vary widely in size and configuration. Most were designed to be evacuated and maintained at low pressure during operation. At low pressures, the plasma can be made uniform over large substrate areas.

42. Subjecting a monomer vapor to a plasma produces a mixture of reactive species that can result in polymer film formation on a surface. The plasma polymer film tends to have a more complex chemical structure than the simple repeating chains resulting from conventional polymer synthesis. Ex. 1010 at 2:14-24; Ex. 1023 at 8724. However, some plasma conditions, such as pulsed excitation, favor the same reaction pathways present in conventional polymerization. Ex. 1019 at 2032.

43. Under plasma conditions, free radical species can combine with intact monomers to promote the conventional free radical polymerization pathway, provided the monomers contain one or more carbon-carbon double bonds. The free radical combines with a monomer to form a single product. In the product, the double bond is replaced by a single carbon-carbon bond. One carbon of a new single bond also participates in a new bond with the original free radical reactant. The second carbon of the new single bond becomes a new free radical site. Hence, the product can react with another monomer to produce another free radical, a process known as

free-radical propagation. The propagation can repeat tens or hundreds of times before another type of reaction terminates the chain growth. By 2015, monomers used for plasma polymerization frequently contained at least one double bond to take advantage of that propagation mechanism. Free radical polymerization is desirable because the resulting polymers retain the chemical functional groups present in the monomer. Ex. 1023 at 8724. The functional groups incorporated in the polymers determine the film properties. Ex. 1034 at 469, col. 2.

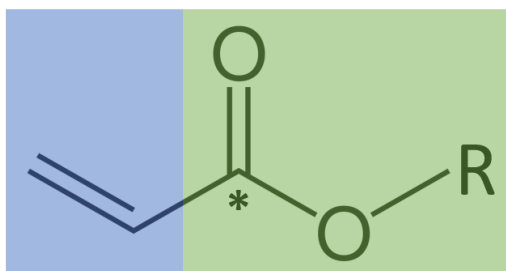
44. Plasma polymerization was known to be an advantageous technique for applying coatings to electronic devices. For example, gas-phase plasma deposition allowed skilled artisans to apply polymer coatings to both external and internal surfaces of a device. Ex. 1012 at 8:1-4, 15:15-20, 16:20-24. It was also considered to be dry technique that creates polymer coatings without exposing the underlying electronics to liquids, unlike solution-based polymerization techniques. Ex. 1010 at 2:10-14; Ex. 1012 at 15:15-20. Plasma polymerization also provided even, conformal coatings across curved or irregular surfaces and provided improved substrate adhesion. Ex. 1006 at 610; Ex. 1005 at 4:1-3; Ex. 1012 at 8:15-21.

C. Monomer reagents for plasma polymerization

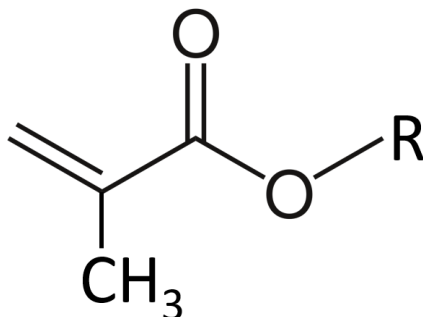
45. Monomers for plasma polymerization often contained unsaturated reactive groups, such as a vinyl group or an acrylic group, useful for forming bonds with other molecules. Ex. 1011 at 3:20-4:3; Ex. 1010 at 7:4-32; Ex. 1005 at 16:7-19;

Ex. 1022 at 3:14-25, 7:21-27; Ex. 1040 at 81. The monomer for a given application was typically selected based on desired polymer properties. For example, monomers bearing hydrophobic structural groups would have been natural choices when seeking to prepare a water-repellent polymer coating.

46. Acrylates and methacrylates were very well-known monomers for polymer production and commonly used in plasma polymerization by 2015. Ex. 1029 at Abstract; Ex. 1011 at 12:7-22; Ex. 1010 at 9:10-16; Ex. 1005 at 11:14-12:3; Ex. 1037 at 26-33. Acrylate monomers are esters with a vinyl group (containing a carbon-carbon double bond) linked to an ester group:

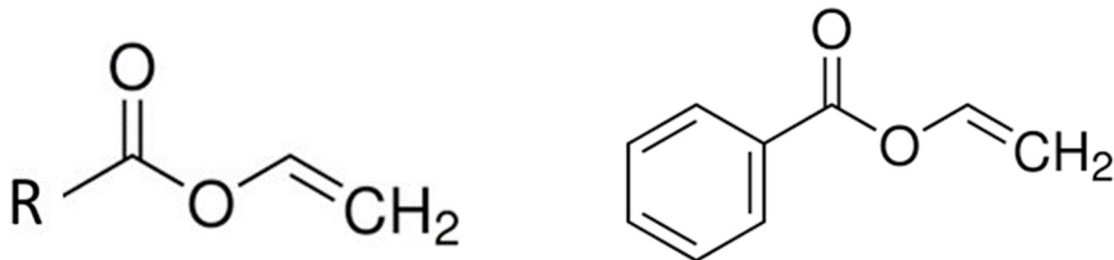


The blue shading above indicates the vinyl group, and the green shading indicates the ester group. The vinyl group is connected by a bond to the carbonyl carbon (indicated above by a star) of the ester group, and the ester group can include a variety of functional groups, indicated by an R. The structure above shows a generic acrylate monomer. In a methacrylate, the carbon-carbon double bond has an added methyl (CH₃) substituent, as shown below.



47. Acrylates and methacrylates were commonly used as monomers for polymer production long before 2015 because their reactivity allows for convenient and cost-effective polymer synthesis and because they can accommodate a variety of functional groups, R, to confer desired properties on the resulting polymers. Ex. 1010 at 1:16-23; Ex. 1019 at 2032; Ex. 1022 at 9:13-20; Ex. 1029 at Abstract.

48. Vinyl esters were another commonplace type of monomer known to undergo free-radical polymerization, including plasma polymerization. Ex. 1033 at 91; Ex. 1041 at 35. In the vinyl ester monomers, the vinyl group is connected by a bond to the single-bonded oxygen atom of the ester group. To achieve different polymer properties, a variety of functional groups, indicated by an R, can be attached to the carbonyl carbon of the ester group. For example, when a phenyl ring is selected as the vinyl ester's functional group (R), as shown below, the resulting monomer is known as vinyl benzoate.



49. Vinyl benzoate is included as a monomer under claim 1 of the '087 patent by taking the vinyl ester R_3 structure on the right-hand side of claim 1 (column 18, lines 50-55), with $n_1=0$ and A being the aryl functional group phenyl ($-\text{C}_6\text{H}_5$). Vinyl benzoate was considered by POSAs to be bifunctional monomer. Ex.1033 at 91 (“The fact that vinyl benzoate prepared by two independent routes yielded gelled copolymers serves to substantiate the belief that this compound is bifunctional in polymerization”). Bifunctional means the vinyl benzoate monomer has two sites that can undergo free radical addition reactions. The conventional site for free radical polymerization is the unsaturated carbon-carbon double bond in the vinyl group of vinyl benzoate. If this was the only polymerizable bond, a soluble, linear polymer would form. The second site is an activated bond on the pendent aromatic ring. Ex. 1033 at 92. The bifunctional nature of vinyl benzoate leads to self-crosslinking upon homopolymerization. Ex. 1033 at 91 (“Mass polymerization of vinyl benzoate produces a cross-linked, hard, brittle, and crystal-clear resin.”). A bifunctional monomer can react at either one site or at both sites. The fraction of the monomers reacting at

both sites create crosslinks. Monomers reacting only through the unsaturated bond cause the retention of the functional group R in the solid polymer.

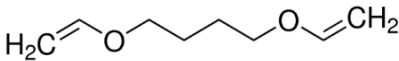
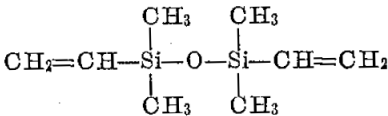
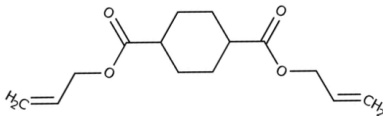
D. Crosslinking and crosslinking reagents

50. Crosslinking refers to connecting linear polymer chains by chemical bonds to form a network. Ex. 1014 at ¶ 11. Crosslinking is a longstanding and widely adopted means to optimize polymer properties for a specific application. For example, crosslinking was known to provide improved mechanical, electrical, and chemical properties in polymer coatings used in the protection of electrical conductors and connectors. Ex. 1008 at ¶¶ 20, 46; Ex. 1048 at 2:42-46; Ex. 1014 at ¶ 2. In plasma polymerization, it was well known that the extent of crosslinking in a polymer could be controlled by co-polymerizing the monomer with varying amounts of a crosslinking reagent. Ex. 1024 at 10:2-7; Ex. 1008 at ¶¶ 20, 46.

51. In general, as a POSA would have known, crosslinkers have at least two reactive unsaturated bonds with an intervening linker moiety. Crosslinkers thus have a multifunctional structure with each unsaturated bond being capable of mediating a new intermolecular bond during chain polymerization. This crosslinker structure forms bonds to more than two monomeric units and thus serves a hub for joining multiple separate polymer chains together during polymerization, resulting in a robust polymer network with interconnected mesh-like structures rather than separate, disconnected polymer chains. Monomers with one unsaturated bond

(monofunctional) can be combined with crosslinking reagents containing more than one unsaturated bond (multifunctional) in the same polymerization reaction. Ex. 1014 at ¶ 52. The multifunctional crosslinking reagent provides crosslinking as desired for a barrier layer which resists moisture. Ex. 1014 at ¶ 52.

52. The prior art commonly described crosslinkers containing two double bonds separated by a variable structure known as a bridging or linking group. Ex. 1010 at 4:4-5:5. I have illustrated several well-known classes of crosslinkers below, showing the configuration of the two double bonds characterizing each class with a generic linking group (Z), as well as a specific example for each class:

Divinyl ether	
configuration	$\text{CH}_2=\text{CH}-\text{O}-\text{Z}-\text{O}-\text{CH}=\text{CH}_2$
example	 1,4-butanediol divinyl ether (BDVE)
Divinyl	
configuration	$\text{CH}_2=\text{CH}-\text{X}-\text{Z}-\text{X}-\text{CH}=\text{CH}_2$ <i>**X is not O, O-(C=O), or CH₂</i>
example	 divinyl tetramethyldisiloxane (DVTMDS)
Diallyl	
configuration	$\text{CH}_2=\text{CH}-\text{CH}_2-\text{Z}-\text{CH}_2-\text{CH}=\text{CH}_2$
example	 diallyl 1,4-cyclohexanedicarboxylate (DCHD)

53. Plasma methods using crosslinkers were reported for the synthesis of crosslinked polymer coatings well before 2015. Ex. 1010 at 4:4-9; Ex. 1014 at ¶¶ 11, 52-54; Ex. 1006 at 607; Ex. 1023 at 8726. Crosslinking reduces the solubility of polymers in water and other liquids, thus enhances the stability of crosslinked polymer films. Ex. 1014 at ¶ 11; Ex. 1025 at ¶ 34. Many linear polymers form semi-crystalline films in which the grain boundaries between crystallites provide pathways for the diffusion of small molecules such as water. Crosslinking tends to make polymer films amorphous. Ex. 1014 at ¶ 39; Ex. 1026 at 6551. Amorphous films

lack grain boundary defects, thus improving the ability of amorphous films to act a protective barrier against diffusion of moisture, oxygen, and other types of vapors and liquids. Ex. 1014 ¶ 36. Thus, the lack of grain boundaries also makes amorphous crosslinked coatings resistant against aging.

54. Crosslinking was known to reduce the surface roughness of polymer films. Ex. 1026 at 6550-52. The degree of crosslinking also was known to affect the mechanical properties and wetting behavior of polymer films. Ex. 1026 at 6552-53; Ex. 1008 at ¶¶ 20, 46. For example, crosslinking of acrylate-based vapor deposited polymer coatings was shown to improve surface wetting properties by reducing contact angle hysteresis. Ex. 1026 at 6552-53. Including crosslinkers in such plasma-polymer coatings was also known to improve the coating's durability. Ex. 1010 at 4:1-9, 4:17-5:5.

55. Many crosslinkers had been used in combination with acrylate and methacrylate monomers to produce crosslinked polymer coatings. Ex. 1004 at 1:15-30, 3:50-65; Ex. 1048 at 3:20-60, Ex. 1014 at ¶¶ 52-54, Ex. 1006 at 607; Ex. 1025 at ¶¶ 11, 20; Ex. 1029 at 6197-98.

56. Plasma polymerization is characterized by its use of plasma ignition to initiate its polymerization reactions. Once activated, plasma polymerization was known to proceed at least in part according to reaction pathways similar to those that occur following conventional activation techniques (like free-radical, solution-phase,

or heat-based polymerization). Ex. 1040 at 81. POSAs therefore understood and expected that the same types of crosslinking reagents used for conventional polymerization would also work in plasma polymerization reactions. For example, Badyal taught that crosslinkers for its plasma-based techniques could be any known in the entire “polymer art,” without limiting consideration to reagents specific for plasma or any other type of polymerization. Ex. 1010 at 4:18-19. As another example, the use of the crosslinker ethylene glycol dimethacrylate (EGDMA) in plasma polymerization was motivated by the use of EGDMA as a crosslinking agent in conventional solution polymer synthesis. Ex. 1023 at 8725; Ex. 1029 at 6206; *see also* Ex. 1010 at 6:25-20 (Formula A) (describing the analogous non-methylated diacrylate ethylene glycol diacrylate (EGDA) as an exemplary crosslinking reagent for plasma polymerization).

57. Plasma polymerization has also been demonstrated using the divinyl crosslinker DVTMDS (Ex. 1039 at 28; Ex. 1041 at 5) and the divinyl ether crosslinker BDVE (Ex. 1006 at 607). These two crosslinker structures appear in the Table shown above.

E. Applications for plasma polymerization

58. Plasma polymerization had been quite widely employed for coating a range of surfaces by 2015. Ex. 1010 at 2:10-12, 10:8-12, 11:26-27; Ex. 1011 at 6:25-7:12; Ex. 1012 at 2:8-3:14, 7:3-21, 8:22-10:12, 11:4-11; Ex. 1005 at 4:14-6:11,

11:17-12:25; Ex. 1016 at 1:40-50; Ex. 1017 at 3:26-40; Ex. 1027 at 1:20-41. Plasma polymerization has been used to apply thin-film coatings utilized in the fabrication of semiconductor devices such as integrated circuits. Ex. 1017 at Abstract; Ex. 1024 at Abstract. Lipid-repellent and protein-repellant plasma polymer coatings, including crosslinked plasma polymer coatings, have a wide range of applications including cosmetics packaging, modification of laboratory vessels, and biopassivation of implantable medical devices, such as stents, catheter, and pacemakers. Ex. 1025 at ¶¶ 2, 6, 15, 36, 38; Ex. 1006 at Abstract. Plasma polymer coatings were also preferred for the protection of electronic and electrical components and devices from damage by the environment. Plasma polymers were utilized in applications that require a barrier against attack from moisture and oxygen, thus avoiding detrimental effects such as corrosion. Ex. 1014 at ¶¶ 5, 11, 21-24; Ex. 1013 at ¶¶ 1-4, 39-40, 46, Ex. 1005 at Abstract, 16:7-27, 32:14-33:3. For example, water-resistant plasma polymer coatings were used for preventing corrosion in electronic medical devices such as hearing aids. Ex. 1015 at ¶¶ 2, 11, 29-35.

59. POSAs in 2015 also knew that functionalizing solid surfaces with plasma polymers could provide excellent liquid repellency. Ex. 1019 at 2038. Plasma polymer coatings which resist wetting by water and oils were pursued for preserving solid surfaces including metals, ceramics, glass, paper, and plastics and for the surface modification of cloth. Ex. 1010 at 1:8-12. Experimental methods to

determine the contact angle of a liquid droplet on a surface were well known by 2000. Ex. 1043 at 64. For a liquid to form droplets rather than spreading freely over a solid surface, the liquid must have a higher surface tension than the solid surface. Ex. 1043 at 64. Liquid water has a surface tension of approximately 72 dyne/cm. Ex. 1044 at 15:19. Solid surfaces with surface tensions lower than that of water are desired to reduce wettability. The formation of a droplet maintains portions of the low free-energy solid surface exposed to air and, thus, lowers the overall free energy of the interface. The lower the surface tension of the solid surface, the greater the contact angle of the droplet.

60. Plasma-modified fabrics can be waterproof and soil-resistant, making them desirable in the production of clothing such as outerwear, sports jerseys, and military uniforms. Ex. 1010 at 1:14-19. Plasma polymers with durable water repellency and soil-resistance are also desirable other outdoor products and components manufactured from fabrics and leather, such as footwear, umbrellas, tents, sleeping bags, and awnings. Ex. 1021 at ¶¶ 1-12. The plasma coating method was known to be capable of coating the substrate surface without infilling the spaces between surface features. Thus, the coated substrates can still retain openings for the passage of air. Crosslinking of the plasma polymers was known to be desired for durability of the coating against wear. Ex. 1010 at 4:25-29.

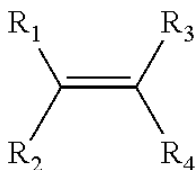
61. Plasma-polymer coatings were well known and commonly used to protect against irreversible damage that can result from exposing electrical circuits to liquids, such as water. Ex. 1011 at Abstract, 1:1-34, 12:7-14:23; Ex. 1005 at 16:11-27; Ex. 1029 at 6197-98. Rain has the potential to damage electronics located outdoors, such as lighting, antennas, and communication equipment. Accidental spillage and plumbing leaks can threaten indoor electronics, such as computers and instrumentation. By 2015, portable electronics were used both indoors and out, and their small size made them prone to spills and accidental immersion. Mobile devices such as laptops, mobile phones, radios, cameras, and hearing aids contained many different electronic components including printed circuit boards (PCBs), batteries, microphones, SIM cards, wires, connectors, lenses, touchscreens, and external buttons that had been protected using plasma polymer coatings. Ex. 1011 at 4:17-5:6, 6:19-23; Ex. 1005 at 1:6-12, 10:14-12:25.

VII. SUMMARY OF THE '087 PATENT AND CLAIMS

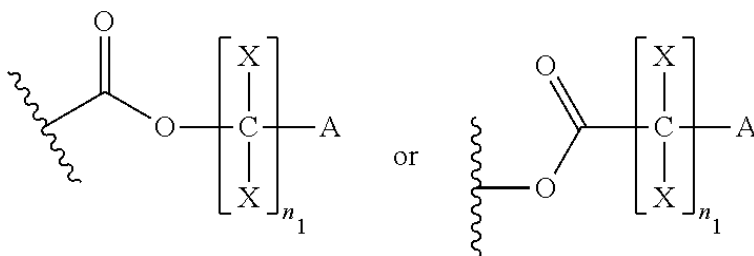
62. The '087 patent (Ex. 1001) is entitled "Coatings." The '087 patent includes fourteen claims. Ex. 1001 at 18:25-21:13. I understand that claim 1 is the only independent claim, and the remaining claims depend from claim 1 because they refer back directly or indirectly to claim 1 and incorporate all of its requirements. The '087 patent discusses and claims crosslinked plasma polymer coatings applied to electronic devices. Ex. 1001 at Abstract, claim 1. According to the '087 patent, the

coatings can be water repellent or can form a barrier to protect the underlying electronics from damage. Ex. 1001 at 1:14-22. The electronics include “a wide variety of substrates” such as “mobile phones, smartphones and pagers, radios, and sound and audio systems such as loudspeakers, microphones,” or circuit boards. Ex. 1001 at 14:37-63. Most of the patent’s disclosure pertains to the compounds used as monomers and crosslinkers to prepare the coatings. Ex. 1001 at 4:37-13:8.

63. The '087 patent describes using a monomer having a double bond to prepare the plasma polymer surface coatings. Ex. 1001 at 9:25-35. According to claim 1, the monomer has the following required generic structure:



with R₃ having one of the following two structures:



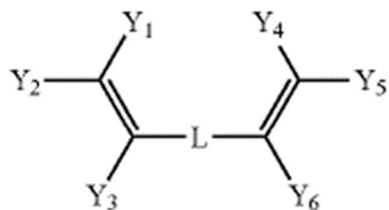
Ex. 1001 at claim 1 (18:36-62).

64. A POSA would have recognized that these are two generic structures both containing the ester functional group, $-\text{C}(=\text{O})-\text{O}-$. A POSA would have known the structure on the left describes acrylate and methacrylate monomers, while the

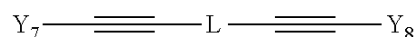
structure on the right characterizes vinyl ester monomers. A POSA would have known that acrylate, methacrylate, and vinyl ester monomers are useful for free-radical polymerization processes, including plasma polymerization. Ex. 1005 at 11:14-12:3; Ex. 1011 at 12:7-22; Ex. 1010 at 9:10-16; Ex. 1008 at ¶¶ 23-24; Ex. 1037 at 26-33; Ex. 1041 at 35, col 1; Ex. 1029 at 6197-99; Ex. 1033 at 91; Ex. 1041 at 35, col 1.

65. According to claim 1, the R_3 structures have a variable-length CX_2 chain of length “ n_1 ,” which is an integer ranging from 0 to 27. Ex. 1001 at 18:62 (“ n_1 is an integer from 0 to 27”). The claimed R_3 structure must also contain a terminal aryl group, which is denoted by “A” in the claims. Ex. 1001 at 18:50-62 (“where A is aryl optionally substituted by halo”). The specification contains limited reference to aryl groups, stating only that variable positions in the disclosed monomers may contain “aryl optionally substituted by halo.” Ex. 1001 at 2:52, 9:49, 10:26, 13:12. I have reviewed the '087 patent, and it does not disclose an example of an aryl monomer or any specific aryl group.

66. Claim 1 further requires using a crosslinking reagent with two or more unsaturated bonds attached by one or more linker moieties (L) with a boiling point at less than 500°C at standard pressure. Ex. 1001 at 18:31-33, 18:62-66. The cross-linker must have one of the following two structures:



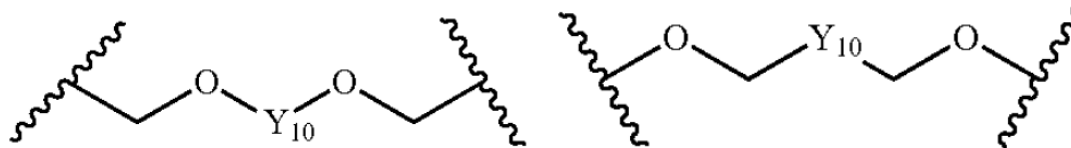
Compound (i)



Compound (ii)

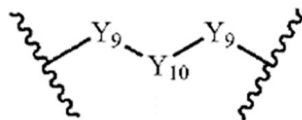
Ex. 1001 at 18:62-19:14. Compound (i) represents a group of alkene crosslinkers with two double bonds, and compound (ii) represents a group of alkyne crosslinkers with two triple bonds. Ex. 1001 at 4:38-41 (“A basic requirement for the cross-linking reagent is the presence [of] two or more unsaturated bonds, for example, $-\text{C}=\text{C}-$ or alkyne groups.”). The patent states that the identity of the bridging group is “not especially limited,” which indicated to a POSA that a variety of crosslinkers having different bridging-group structures between the double bonds could be used. Ex. 1001 at 4:38-43 (“The linker moiety is not especially limited provided it joins together the two or more unsaturated bonds”).

67. Claim 1 recites three possible alternative forms for the structure of linker moiety (L) in the alkene crosslinking reagents of compound (i). Claim 1 refers to the first two generic linker moiety structures as “Formula A”:

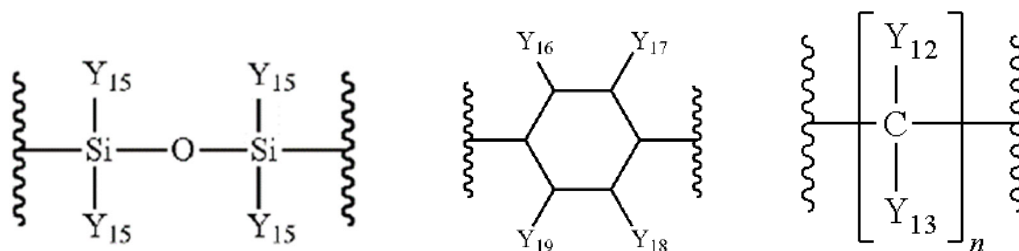


Ex. 1001 at 19:15-29. For this “Formula A,” the variable Y_{10} position can be “selected from optionally substituted cyclic, branched or straight chain C_1 - C_8 alkylene and a siloxane group.” Ex. 1001 at 19:15-29.

68. Claim 1 refers to the third alternative structure as “Formula B,” which has the following generic structure:



Ex. 1001 at 19:30-38. Under Formula B, claim 1 further specifies multiple alternative configurations for Y_9 : “each Y_9 is independently selected from, a bond, ---O--- , ---O---C(O)--- , ---C(O)---O--- , $\text{---}Y_{11}\text{---O---C(O)---}$, $\text{---C(O)---O---}Y_{11}\text{---}$, $\text{---O}Y_{11}\text{---}$, and $Y_{11}\text{O---}$, where Y_{11} is an optionally substituted cyclic, branched or straight chain C_1 - C_8 alkylene.” Ex. 1001 at 19:38-42. Claim 1 further specifies three alternative structures for substituent Y_{10} in Formula B:



Ex. 1001 at 19:42-20:11.

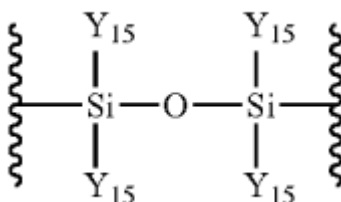
69. Thus, as is apparent, independent claim 1 encompasses a wide variety of crosslinkers, with a range of possible configurations, i.e., either generic compound

(i) or generic compound (ii), with various structures of Formula A or B that could be the linker moiety in the generic compound (i) structure.

70. Dependent claims 2 and 3 add that the coating provides liquid repellency or a physical barrier. Ex. 1001 at claim 2 (20:12-14) (“the protective cross-linked polymeric coating is a physical barrier to mass and electron transport”), Ex. 1001 at claim 3 (20:15-18) (“the protective cross-linked polymeric coating forms a liquid repellent surface defined by a static water contact angle (WCA) of at least 90°”).

71. Dependent claim 4 restricts n to range from 4-6. Ex. 1001 at claim 4 (20:19-20) (“wherein n is from 4 to 6”).

72. Dependent claim 5 adds additional structural limitations within the linker-moiety group of compound (i). Claim 5 requires that Y₁₀ within the linker moiety has the following formula:



where “Y₁₅ is methyl, and each Y₉ is a bond.” Ex. 1001 at claim 5 (20:21-31).

73. Claim 7 limits the crosslinking reagent to one of several specific cross-linkers: “the crosslinking reagent is selected from 1,4-butanediol divinyl ether (BDVE), 1,4-cyclohexanedimethanol divinyl ether (CDDE), 1,2,4-

trivinylcyclohexane (TVCH), 1,3-divinyltetramethyldisiloxane (DVTMDS), diallyl 1,4-cyclohexanedicarboxylate (DCHD), 1,6-divinylperfluorohexane (DVPFH), 1H,1H,6H,6H-perfluorohexanediol diacrylate (PFHDA) and glyoxal bis (diallyl acetal) (GBDA).” Ex. 1001 at claim 7 (20:46-53).

74. Dependent claims 9 and 10 recite subgenres of the generic aryl monomer structure set forth in claim 1, with claim 9 requiring “each X is H” and claim 10 requiring “each X is F.” Ex. 1001 at claims 9-10 (20:57-60).

75. Dependent claims 11-14 specify certain kinds of electrical devices or components for the coated substrate, with claims 12-14 depending from claim 11. Ex. 1001 at claim 11 (20:61-21:3) (“the device or component is selected from a mobile phone, smartphone, pager, radio, sound and audio system, hearing aid, personal audio equipment, television, DVD player including portable a DVD player, video recorder, digi or other set-top boxes, computer or related component, personal digital assistant (PDA), keyboard, instrument, games console, data storage device, outdoor lighting system, radio antennae or other form of communication equipment, or printed circuit board”), Ex. 1001 at claim 12 (21:4-6) (“the sound and audio system is a loudspeaker, microphone, ringer and/or buzzer”), Ex. 1001 at claim 13 (21:7-10) (“the personal audio equipment is a personal CD, tape cassette or MP3 player”), Ex. 1001 at claim 14 (21:11-13) (“the computer or related component is a laptop, notebook, tablet, phablet or palmtop computer”).

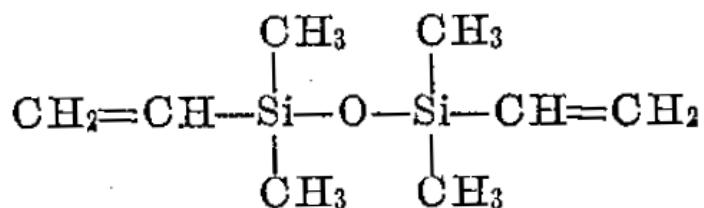
76. The '087 patent's specification describes using a monomer and cross-linker to apply plasma polymer coatings to an electronic device with standard equipment and conditions for plasma coating applications that would have been familiar to a POSA in June 2015. Ex. 1001 at 13:16-14:36, 14:66-15:7; Ex. 1011 at 6:29-10:34, Ex. 1010 at 10:8-11:13, Ex. 1014 at ¶ 23; Ex. 1006 at 606-07; Ex. 1005 at 20:1-26:3.

VIII. THE PRIOR ART

77. I understand from counsel that the following documents are prior art to the '087 patent.

A. Exhibit 1004 – “Cohen”

78. Cohen (Ex. 1004) is U.S. Patent No. 2,716,638. Cohen indicates that the patent application was filed in 1952 and says, “Patented Aug. 30, 1955,” which I understand means the patent issued in 1955. Cohen is titled “Divinyltetramethyldisiloxane and polymers therefrom” and described processes of polymerizing divinyltetramethyldisiloxane (DVTMDS) to form insulating materials for electrical devices. Ex. 1004 at 1:15-20, 5:1-12. As shown in Cohen, DVTMDS has the following chemical structure:



Ex. 1004, 1:30. A POSA would have recognized DVTMDS as a crosslinking reagent because it has two double bonds separated by a linker moiety. A POSA also would have recognized DVTMDS as an organosilane compound because it contains carbon bonded to silicon, and specifically as a siloxane because it contains a silicon-oxygen-silicon group (Si-O-Si). Ex. 1054 at ¶¶ 4-5; Ex. 1055 at ¶ 23. Cohen taught that DVTMDS has a boiling point of 137°C at atmospheric pressure. Ex. 1004 at 3:44-45. DVTMDS was commercially available by 2015. Ex. 1058, 48:35-37.

79. The homopolymerization of DVTMDS yielded a crosslinked material which was infusible and insoluble. Ex. 1004 at 2:10-14. The copolymerization of DVTMDS with several other monomers containing unsaturated bonds was also taught by Cohen. Ex. 1004 at 2:14-30, 4:36-57. Cohen specifically identified two aryl monomers that could be copolymerized with DVTMDS: benzyl acrylate and benzyl methacrylate. Ex. 1004 at 4:38-40. And Cohen taught that such DVTMDS copolymers were suitable for use as insulating materials for electronic devices. Ex. 1004 at 5:1-20.

80. Cohen disclosed that copolymers containing DVTMDS could be prepared using any known polymerization technique, including solution-based polymerization using free-radical initiators like peroxides and ozone. Ex. 1004 at 1:31-60 (“[DVTMDS] may be copolymerized with other copolymerizable materials using any of the methods now known in the art.... Examples of such polymerization

catalysts are oxygen, ozone, ozonides, hydrogen peroxide, organic and inorganic acids and acidic substances, e.g., hydrochloric acid, sulfuric acid, boron fluoride, antimony pentachloride, etc.; organic and inorganic peroxides, for instance, peroxides of the aromatic acid series, e. g., benzoyl peroxide, tertiary butyl perbenzoate, etc.; peroxides of the aliphatic acids, for example, tertiary butyl hydroperoxide, acetyl peroxide, stearyl peroxide, lauryl peroxide, etc.; sodium peroxide, barium peroxide, etc., various percompounds, such as persulphates, perchlorates, perborates, etc.”).

81. Cohen uses the term “vinyl polymerization catalysts” (e.g., Ex. 1004 at 1:45-48; 2:12, 6:15-18) to describe species used to accelerate polymerization. Cohen gives a long list of polymerization catalysts which include many different peroxides, including benzoyl peroxide. Ex. 1004 at 1:49-59. A POSA would have recognized that peroxides were known to accelerate polymerization, but in later literature, these species are termed “initiators.” Ex. 1036 at 202. Thus a POSA would have recognized that the term “vinyl polymerization catalyst” used by Cohen in the 1950’s is the same as the subsequently used term “initiator.” The initiators contain chemical bonds that can cleave to form a reactive free radical centers. Thermal heating can be used to cause bond cleavage. Peroxy compounds contain easily cleaved O–O bonds and were also widely used thermal initiators for conventional free radical polymerization. Ex. 1036 at 210.

B. Exhibit 1005 – “Legein”

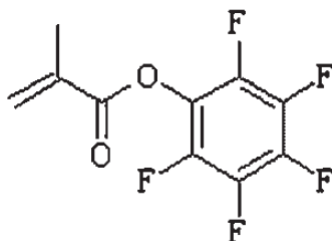
82. Legein (Ex. 1005) is International Patent Application Publication No. WO 2014/026967. The first page states a publication date of February 20, 2014, which I understand means the patent application became publicly known on that date. Legein is titled “Surface coatings” and described plasma polymerization of acrylates and methacrylates with organosilanes to form water-repellant protective coatings for electrical devices. Ex. 1005 at Abstract. Legein described coating electrical components to be “corrosion-resistant” and/or “liquid repellent” by “coating the component by plasma deposition of a polymer coating.” Ex. 1005 at Abstract; *see also* Ex. 1005 at 1:1-17, 4:5-13, 6:10-11, 10:22-11:2, 12:14-25. The plasma coatings were prepared using “any one or more ... precursor monomers” including acrylates, methacrylates, and organosilanes. Ex. 1005 at 4:25-5:2, 10:17-20, 16:7-14. Legein disclosed that plasma polymerization produced uniform, well-adhered polymer coatings that covered all surfaces of the device and provided liquid-repellency. Ex. 1005 at 4:1-13, 6:10-16, 16:7-9, 21:24-22:1, 37:12-22.

C. Exhibit 1006 – “Francesch”

83. Francesch (Ex. 1006) is a scientific journal article that was published in the journal *Plasma Processes and Polymers*. Ex. 1006. A POSA would have recognized *Plasma Processes and Polymers* as a prominent journal in the polymer field published by Wiley-VCH Verlag GmbH & Co. A POSA also would have known

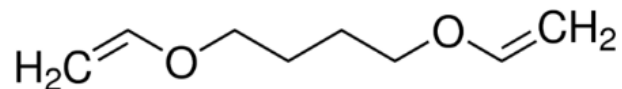
Wiley as an established publisher of scientific and technical articles by 2015. The copyright notice and printed on the first page of the Francesch reference indicates that the article was published in the year 2005, consistent with the 2005 journal citation printed on each page of the article. A POSA reading Francesch would thus have understood from those notations that the article had been published and made available to the public in 2005. Additionally, a declaration signed by Dr. Salvador Borrós Gómez, whom I know to be a co-author of the Francesch article, further demonstrates that the article was made publicly available when it was published online in September 2005. Ex. 1007.

84. Francesch described methods of plasma polymerizing a then-new acrylate-type monomer, pentafluorophenyl methacrylate (PFM) to deposit plasma polymer coatings on a surface, for subsequent biotin binding to achieve versatile surface functionalization. Ex. 1006 at 605-06. Francesch explained that the new polymer “was plasma enhanced chemical vapor deposited on silicon wafers.” Ex. 1006 at 605. Francesch taught that the chemical structure of PFM is as follows:



Ex. 1006 at 606.

85. For plasma polymerization of PFM, Francesch described copolymerizing PFM with crosslinkers, including 1,4-butanediol divinyl ether (BDVE). Ex. 1006 at 606-07. As would have been known to a POSA, BDVE has the following chemical structure:



Francesch taught that the crosslinker was included “to improve the solvent resistance of the resulting deposited thin films.” Ex. 1006 at 610.

D. Other References

86. Exhibit 1008 is U.S. Patent Application Publication No. 2012/0037400 to Fields, et al. The first page states a publication date of February 16, 2012.

87. Exhibit 1009 is a publication by Kenji Makino, et al. in the journal *Optics Express*, which is a well-recognized publication of the Optical Society of America (OSA). By June 2015, POSAs knew the OSA as a well-established publisher of scientific and technical literature in the field, and *Optics Express* was one such publication that would have been known to a POSA. The copyright notice and the journal citation printed at the bottom of each page of Exhibit 1009 indicate that the article was published in 2012. Given those notations, a POSA reading Exhibit 1009 would have understood and believed that the article had been published and made available to the public in 2012.

88. Exhibit 1010 is International Patent Application Publication No. WO 99/64662 to Jas Pal Singh Badyal, et al. The first page states a publication date of December 16, 1999.

89. Exhibit 1011 is International Patent Application Publication No. WO 2007/083122 to Stephen Coulson. The first page states a publication date of July 26, 2007.

90. Exhibit 1012 is International Patent Application Publication No. WO 2012/158953 to Legein, et al. The first page states a publication date of November 22, 2012.

91. Exhibit 1013 is U.S. Patent Application Publication No. 2013/0176700 to Stevens, et al. The first page states a publication date of July 11, 2013.

92. Exhibit 1014 is U.S. Patent Application Publication No. 2007/0020451 to Padiyath, et al. The first page states a publication date of January 25, 2007.

93. Exhibit 1015 is U.S. Patent Application Publication No. 2005/0141738 to Karamuk. The first page states a publication date of June 30, 2005.

94. Exhibit 1016 is U.S. Patent No. 6,551,950 to Badyal, et al. The first page states the date of the patent as April 22, 2003, which I understand to be when the patent was issued.

95. Exhibit 1017 is U.S. Patent No. 4,562,091 to Sachdev, et al. The first page states the date of the patent as December 31, 1985, which I understand to be when the patent was issued.

96. Exhibit 1018 is U.S. Patent No. 7,439,315 to Kunimi, et al. The first page states the date of the patent as October 21, 2008, which I understand to be when the patent was issued.

97. Exhibit 1019 is a publication by S.R. Coulson, et al. in the journal *Chemistry of Materials*, which is a well-recognized publication of the American Chemical Society (ACS). By June 2015, POSAs knew the ACS as a well-established publisher of scientific and technical literature in the field, and *Chemistry of Materials* was one such prominent journal publication that would have been well known to a POSA. The copyright notice and the journal citation printed on each page of Exhibit 1019 indicate that the article was published in 2000, consistent with the additional notation printed near the bottom of the article's first page indicating that it was "Published on Web 06/28/2000." By 2000, ACS and other academic journals in the field were commonly publishing their articles in online and print form. Given that common and by then widespread practice, a POSA reading Exhibit 1019 would have understood from those notations and believed that the article had been published and made available to the public in 2000, and specifically made publicly available on the internet by June 28, 2000.

98. Exhibit 1020 is U.S. Patent Application Publication No. 2005/0034667 to N. Tsuji, et al. The first page states a publication date of February 17, 2005.

99. Exhibit 1021 is U.S. Patent Application Publication No. 2010/0203347 to Coulson. The first page states a publication date of August 12, 2010.

100. Exhibit 1022 is International Patent Application Publication No. WO 98/58117 to Badyal, et al. The document lists a publication date of December 23, 1998, on its first page.

101. Exhibit 1023 is a publication by C. Tarducci and colleagues in the journal *Macromolecules*, which was a recognized journal in the field published by the ACS that would have been well known to a POSA in June 2015. The copyright notice and the journal citation printed on each page of Exhibit 1023 indicate that the article was published in 2002, consistent with the additional notation printed near the bottom of the first page indicating that it was “Published on Web 10/12/2002.” A POSA reading Exhibit 1023 would have understood from those notations and believed that the article had been published and made available to the public in 2002, and specifically made publicly available on the internet by October 12, 2002.

102. Exhibit 1024 is U.S. Patent No. 6,214,423 to Lee, et al. The first page states the date of the patent as April 10, 2001, which I understand to be when the patent was issued.

103. Exhibit 1025 is International Patent Application Publication No. WO 2012/168440 to Taesler. The document lists a publication date of December 13, 2012.

104. Exhibit 1026 is a publication authored by me and my colleague, Jose Luis Yagüe, in the journal of *Macromolecules*. Near the bottom of the first page, the article states that it was published on August 13, 2013. That date is consistent with my own recollection. Based on my personal knowledge as an author of the article, I know that Exhibit 1026 was published in 2013.

105. Exhibit 1027 is U.S. Patent No. 6,207,238 to Affinito. The first page states the date of the patent as March 27, 2001, which I understand to be when the patent was issued.

106. Exhibit 1028 is what I understand to be an excerpted copy of the prosecution history of the '087 patent.

107. Exhibit 1029 is a publication by W. Yao, et al., titled "Fluorinated poly(meth)acrylate: Synthesis and properties" in the journal *Polymer*, which was a recognized journal in the field published by Elsevier that would have been known to a POSA by June 2015. Elsevier was known to POSAs as a well-established publisher of scientific journals. The copyright notice on the first page of Exhibit 1029 and the journal citation printed on every page indicate that the article was published in 2014. A POSA reading Exhibit 1029 would have understood from those notations that the article had been published and made available to the public in 2014.

108. Exhibit 1030 is a publication by Toyama, M., et al., titled “Surface Wettability of Alkyl Methacrylate Polymers and Copolymers,” in the *Journal of Colloid and Interface Science*, which was a recognized journal in the field published by Academic Press that would have been known to a POSA by June 2015. Academic Press was known to POSAs as a well-established publisher of scientific journals. The copyright notice and the journal citation printed on the first page of Exhibit 1030 indicate that the article was published in 1974. A POSA reading Exhibit 1030 would have understood from those notations that the article had been published and made available to the public in 1974.

109. Exhibit 1031 is a publication by Syromyatnikov, V.G., et al., titled “Aryl (meth)acrylates and polymers based on them” in the journal *Russian Chemical Reviews*, which was a recognized journal in the field published by the Russian Academy of Sciences that would have been known to a POSA by June 2015. The Russian Academy of Sciences was known to POSAs as a well-established publisher of scientific journals. The copyright notice and the journal citation printed on the first page of Exhibit 1031 indicate that the article was published in 1999. A POSA reading Exhibit 1031 would have understood from those notations that the article had been published and made available to the public in 1999.

110. Exhibit 1032 is a publication by Gargallo, L. et al., titled “Polymer conformation and viscometric behavior” in the journal *Polymer Bulletin*, which was a

recognized journal in the field published by Springer-Verlag that would have been known to a POSA by June 2015. Springer was known to POSAs as a well-established publisher of scientific journals. The copyright notice and the journal citation printed on the first page of Exhibit 1032 indicate that the article was published in 1983. A POSA reading Exhibit 1032 would have understood from those notations that the article had been published and made available to the public in 1983.

111. Exhibit 1033 is a publication by Ham, G.E. et al., titled “Cross-linking in the polymerization of vinyl benzoate and related compounds” in the *Journal of Polymer Science*, which was a recognized journal in the field published by Wiley that would have been known to a POSA by June 2015. Wiley was known to POSAs as a well-established publisher of scientific journals. The citation information at the top of the first page of Exhibit 1033 indicates that the article was published in Volume 8, issue number 1 of the *Journal of Polymer Science*. A POSA reading Exhibit 1033 would have known that particular issue of the *Journal of Polymer Science* was published in January 1952.¹ That is also consistent with the notation on the first page of the article indicating that it was presented publicly at the International Congress of Pure and Applied Chemistry in New York in September 1951 and the notation on the last page of the article indicating that it was received by the journal in August 1951. A POSA reading Exhibit 1033 thus would have understood that the article had

¹ See <https://onlinelibrary.wiley.com/loi/26424169/year/1952>

been published and made available to the public in 1952, and certainly well before June 2015.

112. Exhibit 1034 is a publication by Asandulesa, M., et al., titled “Chemically polymerization mechanism of aromatic compounds under atmospheric pressure plasma conditions” in the journal *Plasma Processes and Polymers*, which was a recognized journal in the field published by Wiley that would have been known to a POSA by June 2015. Wiley was known to POSAs as a well-established publisher of scientific journals. The copyright notice and the journal citation printed on each page of Exhibit 1034 indicate that the article was published in 2013. A POSA reading Exhibit 1034 would have understood from those notations that the article had been published and made available to the public in 2013.

113. Exhibit 1035 is a publication by Chen, Y., et al., titled “The influence of alkylene spacers on conformational and thermal properties of poly(aryl methacrylates),” in the *Journal of Polymer Science*, which was a recognized journal in the field published by Wiley that would have been known to a POSA by June 2015. Wiley was known to POSAs as a well-established publisher of scientific journals. The copyright notice and the journal citation printed on the first page of Exhibit 1035 indicate that the article was published in 1994. A POSA reading Exhibit 1035 would have understood from those notations that the article had been published and made available to the public in 1994.

114. Exhibit 1036 is an excerpted copy of the fourth edition of a book by George Odian, titled *Principles of Polymerization*. Exhibit 1036 would have been familiar to a POSA, and I have used that book as a reference for years, going back well before 2004. The copyright notations on Exhibit 1036 indicate that it was published in 2004 by Wiley. Wiley was known to POSAs as a well-established publisher in the field. A POSA reading Exhibit 1036 would have understood from those copyright notations and believed that Exhibit 1036 was published and made available to the public in 2004.

115. Exhibit 1037 is a publication by S. Kurosawa, et al., titled “Detection of deposition rate of plasma-polymerized acrylate and methacrylate derivatives using quartz crystal microbalance” in the journal *Thin Solid Films*, which was a recognized journal in the field published by Elsevier that would have been known to a POSA in June 2015. Elsevier was known to POSAs as a well-established publisher of scientific journals. The copyright notice near the bottom of the first page lists a 2003 copyright date, and the journal citation printed on each page indicate that the article was published as part of the 2004 volume of *Thin Solid Films*. A POSA reading Exhibit 1037 would have understood from those notations and believed that the article had been published and made available to the public by 2004, and certainly well before June 2015.

116. Exhibit 1038 is a publication by H. Teng, et al., titled “Property modification of poly(methyl methacrylate) through copolymerization with fluorinated aryl methacrylate monomers,” in the journal *Polymers for Advanced Technologies*, which was a recognized journal in the field published by Wiley that would have been known to a POSA in June 2015. Wiley was known to POSAs as a well-established publisher of scientific journals. The copyright notice and journal citations printed near the bottom of each page indicate that the article was published in 2007. A POSA reading Exhibit 1038 would have understood from those notations and believed that the article had been published and made available to the public in 2007.

117. Exhibit 1039 is a publication by Rau, C., et al., titled “Mechanisms of plasma polymerization of various silico-organic monomers,” in the journal *Thin Solid Films*, which was a recognized journal in the field published by Elsevier that would have been known to a POSA in June 2015. Elsevier was known to POSAs as a well-established publisher of scientific journals. The copyright notice and journal citation printed on the first page of Exhibit 1039 indicate that the article was published in 1994. A POSA reading Exhibit 1039 would have understood from those notations and believed that the article had been published and made available to the public in 1994.

118. Exhibit 1040 is an excerpted copy of a book by H. Yasuda entitled *Plasma Polymerization*. Exhibit 1034 would have been familiar to a POSA, and I

have used that book as a reference for years, going back well before 2015. The copyright notations on Exhibit 1040 indicate that it was published in 1985 by Academic Press. Academic Press was known to POSAs as a well-established publisher in the field. A POSA reading Exhibit 1040 would have understood from those copyright notations and believed that Exhibit 1040 was published and made available to the public in 1985.

119. Exhibit 1041 is a publication by Kurosawa, S., et al., titled “Detection of the Deposition Rate of Plasma-Polymerized Films with a Quartz Crystal Microbalance,” in the *Journal of Photopolymer Science and Technology*, which was a recognized journal in the field published by The Society of Photopolymer Science and Technology that would have been known to a POSA in June 2015. The Society of Photopolymer Science and Technology was known to POSAs as a well-established publisher of scientific journals. The copyright notice printed on the first page of Exhibit 1041 and the journal citation printed on every page indicate that the article was published in 2000. A POSA reading Exhibit 1041 would have understood from those notations and believed that the article had been published and made available to the public in 2000.

120. Exhibit 1042 is an excerpted copy of the second edition of a book by J. Clayden, et al., entitled *Organic Chemistry*. Exhibit 1042 would have been a familiar text to a POSA. The copyright notations on Exhibit 1042 indicate that it was

published in 2012 by Oxford University Press. Oxford University Press was known to POSAs as a well-established publisher in the field. A POSA reading Exhibit 1042 would have understood from those copyright notations and believed that Exhibit 1042 was published and made available to the public in 2012.

121. Exhibit 1043 is a publication by Kabza, K., et al., titled “Contact angle goniometry as a tool for surface tension measurements of solids, using Zisman plot method” in the *Journal of Chemical Education*, which was a recognized journal in the field published by the American Chemical Society that would have been known to a POSA in June 2015. The ACS was known to POSAs as a well-established publisher of scientific journals. The journal citation printed on each page of Exhibit 1043 indicate that the article was published in 2000. A POSA reading Exhibit 1043 would have understood from those notations and believed that the article had been published and made available to the public in 2000.

122. Exhibit 1044 is U.S. Patent 7,097,705, “Cationic-anionic blends for dynamic surface tension reduction,” to C.D. Smit, et al. The first page states the date of the patent as August 29, 2006, which I understand to be the date that the patent issued.

123. Exhibit 1045 is a publication by Talib, Z.A., et al., titled “Plasma polymerization of silicon-containing monomers,” in the *Journal of Photopolymer Science and Technology*, which was a recognized journal in the field published by

The Society of Photopolymer Science and Technology that would have been known to a POSA in June 2015. The Society of Photopolymer Science and Technology was known to POSAs as a well-established publisher of scientific journals. The copyright notice printed on the first page of Exhibit 1045 and the journal citation printed on every page indicate that the article was published in 2001. A POSA reading Exhibit 1045 would have understood from those notations and believed that the article had been published and made available to the public in 2001.

124. Exhibit 1046 is a publication by Kurosawa, S., et al., titled “Detection of deposition rate of plasma-polymerized silicon-containing films by quartz crystal microbalance,” in the journal *Thin Solid Films*, which was a recognized journal in the field published by Elsevier that would have been known to a POSA in June 2015. Elsevier was known to POSAs as a well-established publisher of scientific journals. The copyright notice printed on the first page of Exhibit 1046 and the journal citation printed on every page indicate that the article was published in 2002. A POSA reading Exhibit 1046 would have understood from those notations and believed that the article had been published and made available to the public in 2002.

125. Exhibit 1047 is a publication by Liu, J., et al., titled “Microbial degradation of polyfluoroalkyl chemicals in the environment: A review,” in the journal *Environment Journal*, which was a recognized journal in the field published by Elsevier that would have been known to a POSA in June 2015. Elsevier was known to

POSAs as a well-established publisher of scientific journals. The copyright notice printed on the first page of Exhibit 1047 and the journal citation printed on every page indicate that the article was published in 2013. A POSA reading Exhibit 1047 would have understood from those notations and believed that the article had been published and made available to the public in 2013.

126. Exhibit 1048 is U.S. Patent No. 3,816,564 to H.R. Holliday, et al. The first page states the date of the patent as June 11, 1974, which I understand to be when the patent was issued.

127. Exhibit 1049 is U.S. Patent No. 8,389,070 to S.R. Coulson, et al. The first page states the date of the patent as March 5, 2013, which I understand to be when the patent was issued.

128. Exhibit 1050 is a collection of chemical information about 1,4-butanediol divinyl ether (BDVE) (CAS No. 3891-33-6) obtained from chemspider.com, which is an online resource maintained by the Royal Society of Chemistry that I and others of ordinary skill in the field consider reliable and use regularly to look up properties of chemical reagents, such as molecular structure, boiling point, molecular weight, density, etc.

129. Exhibit 1051 is a collection of chemical information about pentafluorophenyl methacrylate (PFM) (CAS No. 13642-97-2) obtained from chemspider.com, which is an online resource maintained by the Royal Society of Chemistry that I and

others of ordinary skill in the field consider reliable and use regularly to look up properties of chemical reagents, such as molecular structure, boiling point, molecular weight, density, etc.

130. Exhibit 1052 is a publication by K.G. Joback and R.C. Reid in the journal *Chemical Engineering Communications*, which was a recognized journal in the field published by Taylor & Francis that would have been well known to a POSA by June 2015. Taylor & Francis was known to POSAs as a well-established publisher of scientific journals. The copyright notice and the journal citation printed on page 233 of Exhibit 1037 indicate that the article was published in 1987. In addition, the cover page to the article near states that the article was published online as of May 21, 2007. A POSA reading Exhibit 1037 would have understood from those notations and believed that the article had been published and made available to the public before 2015, and specifically made publicly available in print in 1987 and on the internet in 2007.

131. Exhibit 1053 is International Patent Application Publication No. WO 2013/019492 to S. Traser. The document lists a publication date of February 7, 2013.

132. Exhibit 1054 is U.S. Patent Application Publication No. 2010/0224568 to S. Selcuk. The first page states a publication date of September 9, 2010.

133. Exhibit 1055 is U.S. Patent Application Publication No. 2010/0152377 to J. Chen, et al. The first page states a publication date of June 17, 2010.

134. Exhibit 1056 is International Patent Application Publication No. WO 2012/109228 to W. Laredo. The document lists a publication date of August 16, 2012.

135. Exhibit 1057 is a publication by D.C.G. Muir, et al., titled “Are there other persistent organic pollutants? A challenge for environmental chemists” in the journal *Environmental Science & Technology*, which was a recognized journal in the field published by the American Chemical Society that would have been known to a POSA in June 2015. The ACS was known to POSAs as a well-established publisher of scientific journals. The copyright notation printed on the first page of Exhibit 1057 and the journal citation printed on each page indicate that the article was published in 2006. A POSA reading Exhibit 1057 would have understood from those notations and believed that the article had been published and made available to the public in 2006.

Ex. 1058 is U.S. Patent 8,222,348, “Epoxy silicone and process for producing same, and curable mix composition using same and use thereof,” to Y. Kuroda et al. The first page of the document indicates July 17, 2012, as the date of the patent, which I understand to be the date the patent issued.

IX. CLAIM CONSTRUCTION

136. In conducting my analyses of the claims of the '087 patent, I have applied the understandings I set out below regarding the meanings of terms used in the

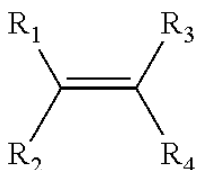
claims. I reserve the right to update or modify my analyses if necessary to account for different meanings assigned to any of the claims.

A. “Aryl”

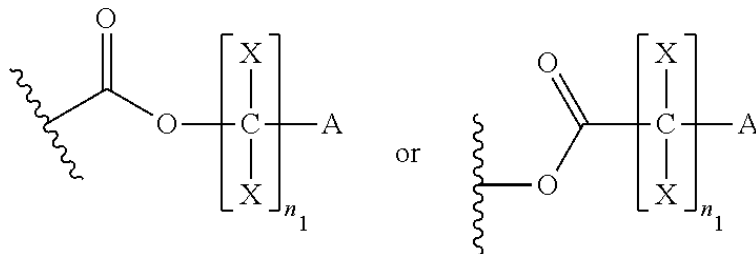
137. In my opinion, a POSA would have understood the term “aryl” in claim 1 of the '087 patent to mean “an aromatic ring system.” That meaning is consistent with the ordinary meaning of “aryl” as used by those in the field in 2015. For example, the Clayden textbook (Ex. 1042) explains that “[a]ny compound containing a benzene ring or a related ... ring system is known as ‘aromatic’, and another useful organic element symbol related to Ph is Ar (for ‘aryl’). While Ph always means C₆H₅, Ar can mean any substituted phenyl ring, in other words phenyl with any number of the hydrogen atoms replaced by other groups.” Ex. 1042 at 24. This meaning is also consistent with how aryl was used in the '087 patent’s specification and during prosecution.

138. Claim 1 recites the term “aryl” several times to identify substituents that can be included at certain sites in the claimed monomers, including at the terminal “A” for the variable R₃ group of the claimed monomer:

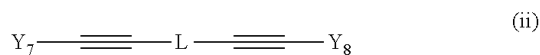
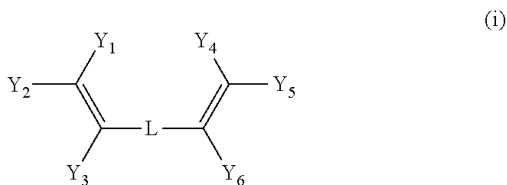
... wherein the monomer compound has the following formula:



where R_1 , R_2 and R_4 are each independently selected from hydrogen, optionally substituted branched or straight chain C_1 - C_6 alkyl or halo alkyl or ***aryl optionally substituted by halo***, and R_3 is selected from:



where each X is independently selected from hydrogen, a halogen, optionally substituted branched or straight chain C_1 - C_6 alkyl, halo alkyl or ***aryl optionally substituted by halo***; where A is ***aryl optionally substituted by halo***; and n_1 is an integer from 0 to 27; and wherein the crosslinking reagent comprises two or more unsaturated bonds attached by means of one or more linker moieties and has a boiling point of less than 500°C . at standard pressure the crosslinking reagent having one of the following structures:

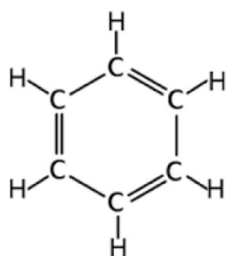


where Y_1 , Y_2 , Y_3 , Y_4 , Y_5 , Y_6 , Y_7 and Y_8 are each independently selected from hydrogen, optionally substituted cyclic, branched or straight chain C_1 - C_6 alkyl or ***aryl***; and L is a linker moiety;

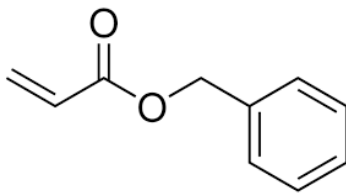
Ex. 1001 at claim1 (excerpted) (emphasis added).

139. The specification of the '087 patent does not define the term “aryl” or provide any specific examples. Ex. 1001 at Abstract, 2:39, 2:52, 5:66, 9:36, 9:50, 10:26, 12:66, 13:11.

140. The ordinary meaning of “aryl” before 2015 (and since) was a structural group containing an aromatic ring system. Benzene (C_6H_6) has long been a well-known aromatic ring system, formed by a six-member ring with alternating single and double bonds:



Ex. 1042 at 156-157. Naphthalene ($C_{10}H_8$) was another well-known aromatic ring system comprised of two six-member rings fused together. It also was well known that aromatic ring systems could be linked as substituents to other molecules. POSAs referred to the resulting functional groups as “aryl.” Well-known aryl groups with an aromatic ring system included phenyl ($-C_6H_5$) and naphthyl ($-C_{10}H_7$), among others. Ex. 1042 at 24, 37-38; Ex. 1022 at 4:26-27. As one example of a compound containing an aromatic ring system, benzyl acrylate contains an unsubstituted phenyl group ($-C_6H_5$) linked through a single CH_2 group to an acrylate ester group:



The prior art further confirms that the ordinary meaning of the term “aryl” referred to an aromatic ring system. Ex. 1010 at 5:9-11 (“The term ‘aryl’ refers to aromatic cyclic groups such as phenyl or naphthyl, in particular phenyl.”); Ex. 1016 at 2:47-49 (same).

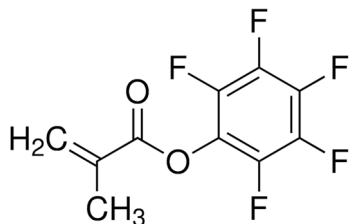
141. This understanding of “aryl” is consistent with how it was used during the prosecution of the '087 patent. During prosecution, original claim 1 required a monomer with an aryl group, Ex. 1028 at 65 (original claim 1 reciting a monomer where “A is aryl optionally substituted by halo”). For this limitation, the examiner cited prior art that described monomers including “benzyl (meth)acrylates” as meeting “the limitations of the formula of the monomer compound of the instant claims”:

However, Huebsch et al. does not disclose the (meth)acrylate esters of aromatic alcohols meets the limitations of the formula of the monomer compound of the instant claims. Kurihara et al. teaches benzyl (meth) acrylate (P4/L147-P5/L165). Kurihara et al. is concerned with coating compositions comprising a copolymer of (meth)acrylic acid derivative containing a perfluoroalkyl group (P1/L10-14). Huebsch et al. and Kurihara et al. are analogous art concerned with similar technical difficulty, namely coatings containing copolymers of fluoro (meth)acrylates. It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention substitute the (meth)acrylate esters of aromatic alcohols per the teachings of Huebsch et al. with the benzyl (meth)acrylates per the teachings of Kurihara et al., and the motivation to do so would have been as Kurihara et al. suggests balance of water repellency and oil repellency of the treated substrate (P4/L147-P5/L165).

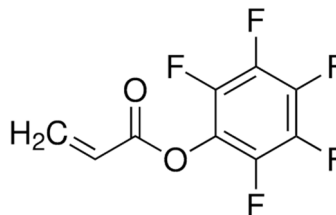
Ex. 1028 at 147. A POSA would have understood that “benzyl (meth)acrylates” refers to both benzyl acrylate and benzyl methacrylate, both of which included an aromatic ring system. In responding, the applicant did not dispute that the claimed aryl monomers encompassed those cited by the examiner. Ex. 1028 at 219-221.

142. Moreover, the '087 patent makes clear that aryl groups include aromatic rings substituted to replace hydrogen with halogen atoms, such as fluorine. Claim 1 of the '087 patent expressly includes “aryl optionally substituted by halo,” Ex. 1001 at 18:47-48, 18:60-62, which a POSA would have understood to refer to compounds having halogenated aromatic rings as aryl compounds. Ex. 1038 at 453. Examples of compounds with a halo-substituted aryl group are pentafluorophenyl methacrylate

(PFM), shown below on the left, and pentafluorophenyl acrylate, shown below on the right:



Pentafluorophenyl methacrylate



Pentafluorophenyl acrylate

Ex. 1038 at 453-54; Ex. 1014 at ¶ 52; Ex. 1029 at 6198 (section 2.2). Those compounds both contain a fluorine-substituted aryl group known as pentafluorophenyl ($-\text{C}_6\text{F}_5$).

143. For these reasons, I conclude that “aryl” in the ’087 patent’s claims should be read to mean “an aromatic ring system.”

B. Other claim terms

144. For purposes of this petition and comparison to the prior art, I understand that all other terms in the claims of the ’087 patent should be given their ordinary meaning to a POSA in the context of the ’087 patent.

X. ANALYSIS OF THE CLAIMS OF THE ’087 PATENT

145. As discussed below, it is my opinion that at least claims 1-5, 7, 9, and 11-14 of the ’087 patent would have been obvious to a POSA in view of the prior art.

A. Ground 1 – Obviousness of claims 1-3, 5, 7, and 9-14 over Cohen and Legein

146. In my opinion, for the reasons explained in more detail below, claims 1-3, 5, 7 and 9-14 of the '087 patent would have been obvious over Cohen and Legein. In summary, Cohen disclosed that the claimed aryl acrylate monomers could be copolymerized with a claimed crosslinker (DVTMDS) using free-radical-initiated chain polymerization, and that the resulting crosslinked polymers could be used for insulating electronic components. Legein disclosed that plasma polymerization is an improved technique for applying protective polymer coatings to electronics and suggested doing so using acrylate, methacrylate, and organosilane compounds, the same classes of compounds disclosed by Cohen. A POSA would have found it obvious to combine Cohen and Legein to prepare electronics with plasma polymer coatings as claimed in the '087 patent.

1. Claim 1

[Preamble] “An electronic or electrical device or electronic or electrical component thereof comprising”

147. Cohen disclosed “an electronic or electrical device or electronic or electrical component thereof comprising.” For example, Cohen disclosed copolymers useful for a “wide variety of commercial applications,” including “in electrical apparatus,” including components such as “capacitors and other electrical devices” and as “cable im[p]regnants, in impregnating electrical coils, as filling compound in

potheads and cable joints, and in numerous other electrical applications.” Ex. 1004 at 5:7-25.

148. Legein also disclosed polymer coatings used for electronic or electrical devices. E.g., Ex. 1005 at 1:3-7 (“The invention also relates to methods of applying surface coatings to articles.... [F]or example the individual components of an electronic (hand held) device.”), 4:5-7 (“Articles are for example the individual components of an electronic (hand held) device.”), 10:14-11:5 (discussing using polymer coatings formed from acrylate, methacrylate, or organosilane on devices that “may be an electronic (hand held) device such as a mobile phone; a smart phone; a personal digital assistant (PDA); a tablet computer; a loudspeaker; a music player such as an MP3 player; an e-reader; a keyboard; a GPS system; a device used for sport such as a pedometer, heart rate monitor, cadence sensor and the like; a video camera; or a photo camera”).

[Limitation 1a] “a protective cross-linked polymeric coating on a surface of the device or component; wherein the protective cross-linked polymeric coating is obtained by exposing the device or component to a plasma comprising a monomer compound and a crosslinking reagent for a period of time sufficient to allow formation of the protective cross-linked polymeric coating on a surface thereof,”

149. Cohen disclosed preparing crosslinked polymers by copolymerization of the crosslinker DVTMDS with another copolymerizable compound. Ex. 1004 at 4:18-28 (“copolymerizable compounds may be separately or simultaneously copolymerized with the divinyltetramethyldisiloxane to obtain new and useful synthetic

compositions”). Specific classes of copolymerizable compounds included esters and vinyl esters. Ex. 1004 at 4:28-31. Cohen identified specific examples of suitable copolymerizable monomer compounds, including benzyl acrylate and benzyl methacrylate. Ex. 1004 at 4:38-57. Cohen disclosed an example of copolymerizing DVTMDS with a methacrylate monomer compound known as methyl methacrylate. Ex. 1004 at 3:52-65 (“A mixture of ingredients comprising, by weight, 15% divinyltetramethyldisiloxane and 85 % methyl methacrylate”), 4:38-57. Upon copolymerizing DVTMDS with that methacrylate monomer, Cohen reported that “there was obtained a rigid homogeneous solid product which showed no tendency to dissolve in acetone over a period of several weeks indicating the cross-linking action of the disiloxane.” Ex. 1004 at 3:58-62. Cohen compared that crosslinked copolymer to a homopolymer produced from methyl methacrylate alone at the same conditions. This pure methyl methacrylate polymer was described by Cohen as able to be dissolved in acetone in less than 24 hours. A POSA would have recognized the ease of dissolving the methyl methacrylate homopolymer (made without DVTMDS) as indicating a linear polymer chain structure without crosslinking.

150. According to the '087 patent, coatings can be protective for electronic devices at least by providing hydrophobicity (i.e., water resistance) or by providing a barrier with high electrical resistance (i.e. insulating). Ex. 1001 at 1:17-22, 3:6-18, 4:11-22. A POSA would have recognized that the copolymers disclosed by Cohen

could be used for protecting electrical devices. In particular, Cohen disclosed that its polymers had protective dielectric (i.e., insulating) properties associated with high electrical resistance and could be used in numerous electrical applications, including to treat or fill an electrical device. Ex. 1004 at 5:1-25 (“as dielectric materials in electrical apparatus” and “[f]or instance, capacitors and other electrical devices may contain a dielectric material comprising the product of polymerization of a polymerizable mass containing divinyltetramethyldisiloxane as an essential ingredient”). As a POSA would have known, electrically insulating (nonconductive) materials can block short circuits caused by the undesired flow of current between two conductive components in an electronic device. Ex. 1005 at 5:13-20.

151. Cohen also taught that DVTMDS-based copolymers could be prepared “using any of the methods now known in the art.” Ex. 1004 at 1:31-34. I understand that the Cohen reference issued as a patent in 1955. At the time, polymerization techniques known in the art would have included solution-based chain polymerization techniques using free-radical initiators like peroxides. Ex. 1004 at 1:35-62.

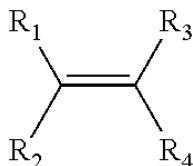
152. Legein disclosed using another polymerization technique—plasma polymerization—to apply protective polymeric coatings specifically onto surfaces of electrical devices and components. Ex. 1005 at 1:3-7 (“The invention also relates to methods of applying surface coatings to articles. Articles are for example the individual components of an electronic (hand held) device.”), 4:5-7 (“Articles are for

example the individual components of an electronic (hand held) device.”), 6:10-11 (“Preferably, the method comprises the step of depositing the precursor monomer by means of low power and/or low pressure plasma polymerisation”). In the disclosed coating processes, an electronic device was placed into a plasma chamber and exposed to a plasma during to achieve plasma deposition. Ex. 1005 at 20:12-21 (“... the individual components of the device are placed into a plasma chamber such that their surfaces, including the electrical contact points, will be exposed to a precursor monomer in the presence of a plasma ...”), 21:20-22:1 (describing “plasma deposition process”), 8:14-17 (describing plasma chamber for “both pre-treatment and polymer coating treatment” of devices). The resulting plasma-polymer surface coatings were “corrosion resistant and/or liquid repellent.” Ex. 1005 at 16:7-9.

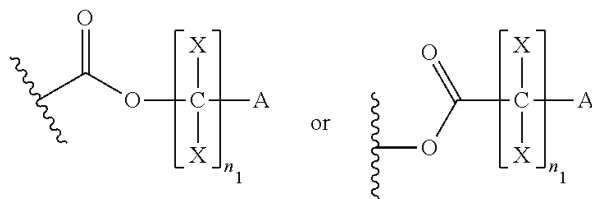
153. Legein disclosed forming protective plasma polymer surface coatings made from any one or more of acrylates, methacrylates, or organosilanes. Ex. 1005 at 10:14-20, 4:22-5:2, 11:14-15. When using an organosilane, Legein also taught that the organosilane compounds preferably included siloxanes. Ex. 1005 at 13:11-12. As a POSA would have known, the organosilane compound DVTMDS described by Cohen is a siloxane. Ex. 1004 at 1:25-30. A POSA also would have known that many of the monomers that Cohen identified as suitable for copolymerizing with DVTMDS were acrylates or methacrylates. Ex. 1004 at 4:36-57.

154. Legein disclosed exposing the electronic-device substrate to the plasma treatment for a sufficient time to form a coating on a surface of the substrate. For example, Legein described polymerization times of “30 seconds to approximately 30 minutes.” Ex. 1005 at 9:15-27. “The longer the polymerisation time the thicker the resultant polymer coating.” Ex. 1005 at 9:15-27.

[Limitation 1b] “wherein the monomer compound has the following formula:

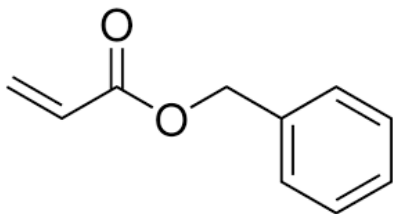
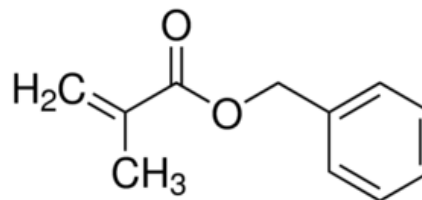


where R₁, R₂ and R₄ are each independently selected from hydrogen, optionally substituted branched or straight chain C₁-C₆ alkyl or halo alkyl or aryl optionally substituted by halo and R₃ is selected from:



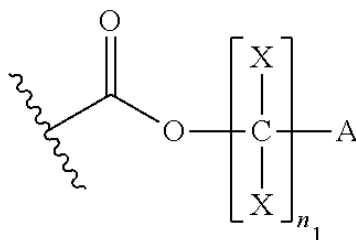
where each X is independently selected from hydrogen, a halogen, optionally substituted branched or straight chain C₁-C₆ alkyl, halo alkyl or aryl optionally substituted by halo; where A is aryl optionally substituted by halo; and n₁ is an integer from 0 to 27

155. Cohen disclosed this limitation. Cohen disclosed using the aryl acrylate monomers benzyl acrylate and benzyl methacrylate having the following structures:

*Benzyl acrylate**Benzyl methacrylate*

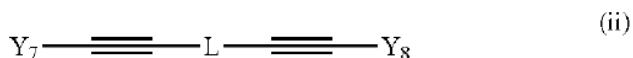
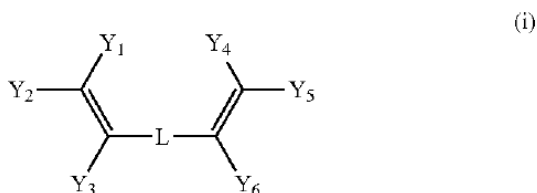
Ex. 1004 at 4:38-39.

156. A POSA would have understood that benzyl acrylate and benzyl methacrylate both satisfied the generic monomer structure recited in claim 1. The chemical structures for these two monomers were shown previously. In particular, a POSA would have understood that for benzyl acrylate, R_1 , R_2 and R_4 are each hydrogen, and for benzyl methacrylate, R_1 and R_2 are hydrogen, and R_4 is a C_1 alkyl group—specifically a methyl (CH_3) group. For R_3 , both benzyl acrylate and benzyl methacrylate are contained the generic structural option recited in claim 1 and shown below:



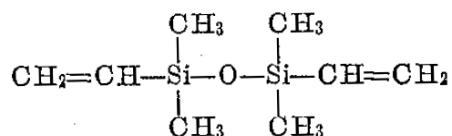
Ex. 1001 at 18:50-57 (left side). And in both benzyl acrylate and benzyl methacrylate, the aryl group A is an unsubstituted aromatic ring (C₆H₅), each X is hydrogen, and n_1 is one.

[Limitation 1c] “and wherein the crosslinking reagent comprises two or more unsaturated bonds attached by means of one or more linker moieties and has a boiling point of less than 500° C. at standard pressure, the crosslinking reagent having one of the following structures:



where Y₁, Y₂, Y₃, Y₄, Y₅, Y₆, Y₇ and Y₈ are each independently selected from hydrogen, optionally substituted cyclic, branched or straight chain C₁-C₆ alkyl or aryl; and L is a linker moiety;”

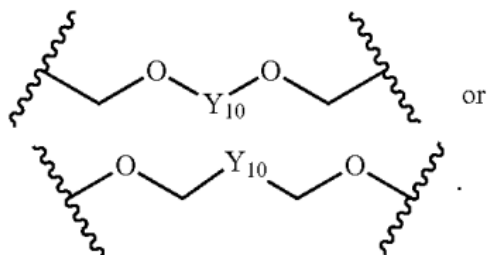
157. Cohen disclosed this limitation. Cohen disclosed crosslinked copolymers made using the crosslinking reagent DVTMDS:



Ex. 1004 at 1:21-34. DVTMDS satisfies the “compound (i)” generic crosslinker formula recited in claim 1. As can be seen, DVTMDS contains two double bonds, a linker moiety between those double bonds, and hydrogen at each of the Y₁₋₆ positions. Moreover, the '087 patent acknowledges that its claimed crosslinker reagent could be DVTMDS, as exemplified by claim 7, which depends from claim 1 and further specifies that the crosslinking reagent is selected from a group that includes “1,3-divinyltetramethyldisiloxane (DVTMDS).” Ex. 1001 at claim 7. The structural formula for DVTMDS set forth in the '087 patent (Ex. 1001 at col. 7-8, Table 1) matches Cohen’s structural formula for DVTMDS.

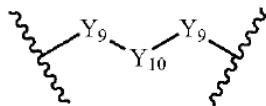
158. Cohen discloses that the boiling point of DVTMDS is “137°C at atmospheric pressure,” which is well below 500°C. Ex. 1004 3:44-45. A POSA would have understood that “atmospheric pressure” is “standard pressure.”

[Limitation 1d] [Formula A] “wherein for compound (i) L is of formula A having one of the following structures:



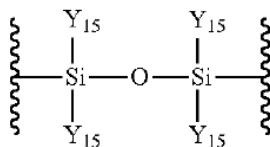
and Y_{10} is selected from optionally substituted cyclic, branched or straight chain C_1 - C_8 alkylene and a siloxane group; or

[Formula B] wherein for compound (i) L is of formula B having the following formula:



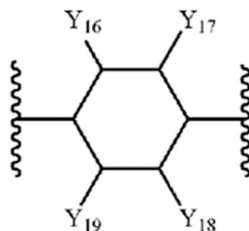
where each Y_9 is independently selected from, a bond, $—O—$, $—O—C(O)—$, $—C(O)—O—$, $—Y_{11}—O—C(O)—$, $—C(O)—O—Y_{11}—$, $—OY_{11}—$, and $Y_{11}O—$, where Y_{11} is an optionally substituted cyclic, branched or straight chain C_1 - C_8 alkylene; and

[Formula B1] wherein Y_{10} has the following formula:



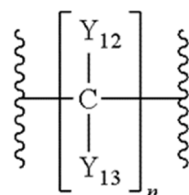
and each Y_{15} is independently selected from optionally substituted branched or straight chain C_1 - C_6 alkyl

or **[Formula B2]** wherein Y_{10} has the following formula:



and Y₁₆ to Y₁₉ are each independently selected from H and optionally substituted branched or straight chain C₁-C₈ alkyl or alkenyl;

or [Formula B3] wherein Y₁₀ has the following formula:

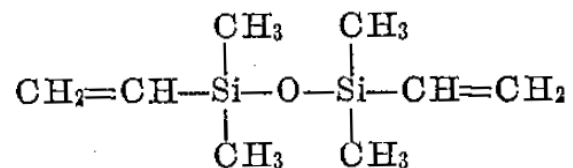


and each Y₁₂ is fluoro and each Y₁₃ is fluoro, and n is an integer from 1 to 10.

159. This limitation is disclosed by Cohen. As can be seen, claim 1 recites alternative, generic structural options for the linker moiety of the compound (i) crosslinking reagents. As indicated above, those structures are divided into formula A, which includes two optional structures, and formula B, which provides a third optional structure. As these are alternatives, I understand that only one of the options from either formula A or B needs to be present in the prior art to disclose this limitation. For formula B, claim 1 further recites three alternative generic substructures for the variable Y₁₀ group within formula B (denoted above as formulas B1, B2, and B3).

160. As previously discussed, Cohen disclosed DVTMDS. Under the structural categories for crosslinking reagents set forth in claim 1 of the '087 patent, a

POSA would have recognized that DVTMDS fits the claimed “compound (i)” cross-linker structure with two double bonds and has a linker moiety that fits within the scope of formula B1. For comparison, the structure of DVTMDS is shown below.



Ex. 1004 1:26-30. This structure is a compound (i) crosslinker as set forth in claim 1 of the '087 patent (Ex. 1001 at 19:1-7), with two double bonds and with hydrogen at each of the Y₁ to Y₆ positions. DVTMDS further contains a tetramethyl disiloxane linker moiety bridging the molecule's two double bonds. The linker moiety in DVTMDS satisfies formula B1 of '087 claim 1 because it has: (1) a bond at each Y₉ position of formula B; (2) the formula B1 disiloxane structure at the Y₁₀ position of formula B; and (3) C₁-C₆ alkyl groups, specifically methyl (–CH₃) groups, at all four Y₁₅ positions of formula B1.

Motivation to Combine Cohen and Legein

161. A POSA would have been motivated to combine the teachings of Cohen and Legein as claimed in the '087 patent. In particular, a POSA would have been motivated to use copolymers for electronic applications prepared from DVTMDS and a monomer including benzyl acrylate or benzyl methacrylate, as disclosed by Cohen, and to apply those polymers to electronic devices via plasma polymerization, as disclosed by Legein.

162. By 2015, portable electronic devices, such as mobile phones and electronic accessories, were ubiquitous. As Legein taught, there was a clear need and market incentive to protect sensitive electronic devices from damage caused by environmental exposure:

It is known to provide an assembled working device with a surface coating in order to protect the device per se against corrosion. For instance, it is known to provide an assembled working mobile phone with a surface coating so that the surface of the mobile phone has water resistant properties.

Ex. 1005 at 1:14-17, 4:5-7, 4:22-26, 12:14-25; *see also* Ex. 1005 at 6:1-8. Such a design incentive would have motivated a POSA to make and apply polymeric coatings that would be suitable to protect electronic devices.

163. As previously discussed, Cohen disclosed preparing crosslinked copolymers by a variety of free-radical initiated chain polymerization techniques. Ex. 1004 1:31-60. A POSA looking to prepare protective coatings for electronics would have considered Cohen's copolymers because, as disclosed by Cohen, those copolymers made using DVTMDS were useful for insulating electronic devices and components. Ex. 1004 at 5:1-25. Cohen, which was issued in the early 1950s, disclosed crosslinked copolymers that could be prepared using familiar, relatively inexpensive, and readily available compounds including DVTMDS and simple acrylates that had been used for decades before 2015.

164. A POSA also would have understood that polymers like Cohen's made using DVTMDS or other organosilicon compounds were known to have water-repellent, barrier, and electrically insulating properties. Ex. 1004, 5:1-12 (insulating); Ex. 1018 1:6-11 (insulating); Ex. 1020 ¶¶ 37, 40-45, (insulating); Ex. 1017 3:27-41, 6:31-36 (moisture-resistant, barrier); Ex. 1005, 4:5-5:13 (insulating, water-repellent). In addition, as discussed above, Cohen disclosed crosslinked polymers, which a POSA would have known improves durability and barrier properties of polymer coatings, as discussed above in the Technical Background. POSAs would have viewed protective coatings with enhanced durability as highly desirable, particularly for devices like mobile phones that are frequently expensive and receive repeated, daily use under a range of conditions for potentially years.

165. Cohen specifically disclosed using several different copolymerization partners with DVTMDS. Ex. 1004 at 2:19-30, 3:53-54, 3:68, 4:7, 4:37-57. In my opinion, it would have been obvious to a POSA to use the disclosed benzyl acrylate or benzyl methacrylate monomers to make copolymers with DVTMDS for coating electronic devices. A POSA would have found it obvious to choose benzyl acrylate or benzyl methacrylate (Ex. 1004 at 4:38-39) from the group of specific compounds Cohen identified as suitable co-polymerization partners for use with DVTMDS for several reasons.

166. By 2015, environmental concerns regarding halogenated organic compounds were prompting POSAs to seek non-halogenated alternatives. Ex. 1005 at 13:6-9; Ex. 1047 at Abstract. For example, the manufacture and use of perfluoroalkyl and polyfluoroalkyl substances (PFAS) was reduced or restricted prior to 2013. Ex. 1047 at 99. The use of PFAS compounds was concerning because these compounds were known to spread easily in the environment, yield degradation products that persist in the environment for a long time, and have the potential to impact human health. Ex. 1047 at 99-100. Similarly, POSAs would have known that many chlorinated organic compounds had been banned or restricted in various countries around the world due to their environmental persistence and toxicity. Ex. 1057 at 7157-58; Ex. 1057 at 7160 (noting that, “[a]s expected, halogenation was associated with the highest toxicity and persistence”). This would have motivated a POSA to prefer non-halogenated monomers among Cohen’s disclosed options.

167. Furthermore, a POSA considering Cohen’s disclosed options would have been motivated to take advantage of the known bifunctional, self-crosslinking nature of aryl monomers. Ex. 1034 at 469. When monomers are exposed to plasma, several different bond breakage processes can produce radicals. One mechanism unique to aryl monomers is the fragmentation of the aromatic ring into a variety of alkyl free radicals. Ex. 1034 at 478. The alkyl groups subsequently incorporated into the plasma polymer were identified by multiple spectroscopic techniques. Thus, the

free-radical growth mechanism in plasma polymer can proceed through aryl groups in addition to unsaturated bonds such as carbon-carbon double or triple bonds. For a monomer having both aryl groups and unsaturated bond, the free-radical polymerization at both types of sites would lead to a crosslinked network polymer. The self-crosslinking of the aryl monomer would be in addition to any crosslinks created by copolymerization with DVTMDS. Since Cohen itself suggested benefits of using monomers capable of crosslinking in combination with DVTMDS (Ex. 1004 at 2:50-56), and since increased crosslinking was desired for polymer layers used to protect electronics against moisture (Ex. 1014 at ¶ 52), a POSA would have been motivated to select self-crosslinking monomers among Cohen's non-halogenated options. That would have included benzyl acrylate, benzyl methacrylate, allyl acrylate, allyl methacrylate, diallyl fumarate, and divinyl ether, among others. Ex. 1004 at 4:38-57.

168. Furthermore, a POSA would have been aware that acrylates and methacrylates had been widely used for plasma polymerization and had been widely used as monomers for effectively applying protective polymer coatings to electronics. Ex. 1005 at Abstract, 4:22-5:1; Ex. 1014 at ¶ 52; Ex. 1012 at 2:6-15; Ex. 1011, 3:14-4:27, 12:7-22. Thus, a POSA would have been motivated to select acrylates and methacrylates from the non-halogenated, self-crosslinking reagents Cohen identified as suitable co-polymerization partners with DVTMDS when selecting a monomer to use for plasma co-polymerization with DVTMDS to make protective polymer

coatings for electronics. And a POSA also would have been motivated to use acrylates and methacrylates with DVTMDS for making a plasma-polymer coating on electronics because Legein specifically identified acrylates and methacrylates as preferred for use in such application in combination with organosilanes (a group that includes DVTMDS). Ex. 1005, 4:22-5:1, 10:14-26. Further selecting for acrylates and methacrylates among Cohen's identified options would have left eight specifically disclosed candidates: benzyl acrylate, benzyl methacrylate, allyl acrylate, allyl methacrylate, tetra-allyl silane methallyl acrylate, diethylene glycol dimethacrylate, glyceryl triacrylate, and ethylene glycol diacrylate. Ex. 1004 at 4:38-57.

169. In my opinion, it would have been obvious to a POSA to try each of those eight disclosed non-halogenated, self-crosslinking, acrylate or methacrylate monomers with DVTMDS. That left benzyl acrylate and benzyl methacrylate as two of a very limited number of specifically identified solutions that Cohen described as suitable for preparing copolymers with DVTMDS that would be useful for electronics applications. It would have been straightforward and obvious to a POSA in 2015 to try any and/or all of the compounds from this limited set of specifically suggested solutions for copolymerization with DVTMDS for electronics applications. Cohen expressly suggested each combination, and a POSA would have known that it had been demonstrated that plasma polymerization could be achieved using a variety of acrylate, methacrylate, and vinyl compounds using the same plasma discharge power.

Ex. 1037 at 29; Ex. 1041 at 34. In addition, it would have been simple to obtain (or make) and test that very limited number of monomers. Based on my experience, I believe that for efficiency reasons a POSA would have started with disclosed monomer options that were commercially available and would have returned to synthesize and test copolymers using any disclosed options that were not commercially available only if none of the commercially available options proved satisfactory. At least benzyl acrylate (Ex. 1053 at 17) and benzyl methacrylate (Ex. 1008 at ¶ 72) were commercially available. In my experience, plasma polymerization and contact-angle testing of a specific copolymer, using one to six composition ratios, could have been accomplished by one POSA in day. I would therefore estimate that one POSA could have assessed eight DVTMDS copolymers in a little over a week; a team working together easily could have accomplished the same work in less than a week.

170. In addition, a POSA would have been motivated to choose the benzyl acrylate and benzyl methacrylate options disclosed by Cohen from among those remaining eight candidates because the presence of aryl groups in those monomers would have been expected to improve barrier properties and water repellency in the resulting polymers. A POSA would have understood that aryl rings of aryl acrylates and methacrylates had been shown to align in a particularly rigid, compact conformation upon polymerization, which a POSA would have expected to present a more robust barrier against intrusion by water or other corrosive molecules. Ex. 1031 at

781; Ex. 1032 at 269. Furthermore, benzyl acrylate was recognized as a hydrophobic monomer. Ex. 1056 at 4:24-6:3. Benzyl methacrylate also would have been considered a hydrophobic monomer. As a POSA would have known, benzyl methacrylate differs in structure from benzyl acrylate only by inclusion of another saturated hydrocarbon (methyl) group. If anything, a POSA would have expected that adding a hydrophobic methyl group to benzyl acrylate would make benzyl methacrylate even more hydrophobic. A POSA also would have known that liquids do not wet surfaces when the surface tension of the liquid exceeds that of the surface. Ex. 1043 at 63. It was known that the surface tension of the homopolymer synthesized from benzyl methacrylate is lower than that of a polymer synthesized from the structurally similar, non-aryl monomer methyl methacrylate, and that increasing the concentration of phenyl groups in a methacrylate-containing copolymer also reduced the surface tension of the resulting copolymer. Ex. 1030 at 802 (Table. 1). Those teachings all would have motivated a POSA to use Cohen's aryl (meth)acrylate monomers, benzyl acrylate and benzyl methacrylate, over Cohen's other specifically disclosed non-halogenated, self-crosslinking, (meth)acrylate compounds.

171. Alternatively, a POSA would have found it obvious to try the benzyl acrylate and benzyl methacrylate among the full list of specific options disclosed by Cohen. In particular, benzyl acrylate and benzyl methacrylate are two of a limited number of specifically identified solutions that Cohen described as suitable for

preparing copolymers with DVTMDS that would be useful for electronics applications. By my count, Cohen described 63 specific compounds as being suitable for co-polymerization with DVTMDS. Ex. 1004 at 2:19-30 (butadiene; isoprene; piperylene; styrene; methylstyrene; acenaphthylene; acrylonitrile; acrylamide; methacrylonitrile; methacrylamide; methyl acrylate; ethyl acrylate; methyl methacrylate;² ethylene; chloroethylene), Ex. 1004 at 3:68 (Example 4, acrylonitrile), Ex. 1004 at 4:7 (Example 5, vinyl acetate), Ex. 1004 at 4:36-57 (benzyl acrylate; benzyl methacrylate; methyl alpha-chloroacrylate; ethyl alpha-bromoacrylate; propyl alpha-chloroacrylate; parachlorostyrene; allyl acrylate; allyl methacrylate; tetra-allyl silane; methallyl acrylate; vinyl methyl ether; vinyl ethyl ether; divinyl ether; methylene methyl malonate; methylene ethyl malonate; vinyl chloride; vinylidene chloride; diethylene glycol dimethacrylate; glyceryl triacrylate; ethylene glycol diacrylate (ethylene diacrylate); diethylene itaconate; diethyl maleate; dimethyl fumarate; para-chlorobenzyl acrylate; diallyl fumarate; diethyl itaconate; diallyl citraconate; divinyl biphenyl; vinyl methyl ketone; cyclopentadiene; 2-chloro-butadiene-1,3 (chloroprene); 2,3-dimethyl-butadiene-1,3; hexadiene-1,5; octadiene-1,4; 2-cyano-butadiene-1,3; dimethylallyl maleate; dimethylallyl itaconate; dimethallyl phthalate; amyl acrylate; hexyl methacrylate; triallyl citrate; triallyl aconitate; triallyl cyanurate;

² Example 3 also identifies methyl methacrylate. Ex. 1004 at 3:53-54.

vinyl acetate; vinyl propionate; vinyl butyrate).³ It would have been straightforward and obvious to a POSA in 2015 to try any and/or all of the compounds from this limited set of specifically suggested solutions for copolymerization with DVTMDS for electronics applications because Cohen expressly suggested each combination, and it would have been simple to make and test that limited number of copolymers. For efficiency reasons, a POSA would have first tested copolymers made using candidate monomers from that list that were commercially available and would have returned to synthesize and test copolymers using any disclosed options that were not commercially available only if none of the commercially available options proved satisfactory. Accordingly, a POSA would have tested at most 63 monomers, if all of Cohen's disclosed specific options were commercially available. As I noted previously, I estimate that one POSA could have made and tested one of the identified DVTMDS copolymer combinations (at one to six composition ratios) per day, so I would estimate that a POSA could have prepared and tested as many as 63 combinations in 2-3 months (with a proportionate reduction of time for any monomers that

³ Cohen also referenced some categories of compounds. *E.g.*, Ex. 1004 at 4:23-36, 4:42-43 (“di- and tri-chlorostyrenes, chlorinated divinyl benzenes”), 4:52-53 (“chlorinated methylstyrenes; chlorinated vinylinaphthalenes”). A POSA would have viewed those as generic suggestions rather than specifically identified solutions.

might have been set aside for lack of commercial availability). A team of POSAs working together, which was more typical in the field, could have performed the same assessment in a few weeks.

172. A POSA would have been motivated to employ plasma polymerization as taught by Legein when applying Cohen's copolymers as coatings to an electronic device. A POSA considering Cohen's disclosed compositions in 2015 would have recognized the benefits of using plasma polymerization for electronic devices over the older techniques disclosed by Cohen, and thus would have been motivated to employ plasma polymerization.

173. For example, Cohen disclosed solution-based techniques that used solvents and liquids (Ex. 1004 at 1:31-44) that potentially could be damaging to sensitive electronics. Plasma polymerization, on the other hand, was recognized as a dry process that avoids having to contact sensitive electronics with liquid polymer precursors. Ex. 1010 at 2:10-14 ("[Plasma deposition] is recognised as being a clean, dry technique that generates little waste compared to conventional wet chemical methods."). Further, Legein taught that plasma polymerization uniformly coats electronics and can reach surfaces inside of an assembled electronic device because the plasma containing gaseous monomer and crosslinker compounds can penetrate through small openings in such devices. Ex. 1005 at 21:20-22:2, 4:1-3, 4:12-13. Legein taught that its disclosed plasma polymerization techniques could provide

improved polymer adhesion to electronic devices and were a “quick and simple, yet cost effective, solution to providing a device with a corrosion resistant protective coating.” Ex. 1005 at 6:18-26, 4:1-3, 37:15-20. A POSA also would have understood that the unique characteristics of polymer films synthesized using a plasma include mechanical and thermal stability, adherence to substrates of different compositions and shapes, and being free from pinhole defects. Ex. 1034 at 469. These properties would have made plasma polymerization attractive for electronics applications because electronics and electronic components often generate heat during operation and have often complex or irregular internal or external surface topography. Given those recognized advantages, it is no surprise that by 2015, plasma polymerization had been widely used to apply protective polymer coatings to electronics. Ex. 1011 Abstract, 1:1-34, 12:7-14:23; Ex. 1012 Abstract; Ex. 1005, 16:11-27; Ex. 1015 ¶¶29-30; Ex. 1014 ¶2.

Reasonable expectation of success.

174. A POSA would have had a reasonable expectation of success in combining Cohen and Legein in the manner claimed in claim 1. The combination is nothing more than applying known polymers and known techniques according to their functions that were well understood in the industry.

175. Cohen specifically taught that benzyl acrylate and benzyl methacrylate could be successfully copolymerized with DVTMDS to obtain useful polymer

compositions. Ex. 1004 at 4:18-23, 4:36-39. Cohen further taught that copolymerization of DVTMDS with other copolymerizable materials containing at least one double bond (like benzyl acrylate and benzyl methacrylate) could be carried out using any then-known polymerization method (Ex. 1004 at 1:31-34, 2:14-19), indicating to a POSA that such compounds would be easy to copolymerize and readily adaptable to various polymerization techniques.

176. As demonstrated by the prior art, plasma polymerization was well-known, routine, and widely used by POSAs before June 2015, and therefore was within the ordinary skill of a POSA. Ex. 1010 at 2:10-13 (“Plasma deposition techniques have been quite widely used for the deposition of polymeric coatings onto a range of surfaces.”), 10:8-12 (“routine methods”). Moreover, Cohen described using free-radical activated chain polymerization (using free-radical initiators like peroxides) to copolymerize DVTMDS with other copolymerizable monomers. Ex. 1004 at 1:45-62. A POSA would have understood that a polymerization reaction successfully carried out using one free-radical activation method for chain polymerization generally can be carried out using other free-radical-mediated chain polymerization processes, like plasma polymerization. Ex. 1036 at 227; Ex. 1037 at 31-32. A POSA thus would have expected Cohen’s disclosed copolymerization between DVTMDS and other monomers like benzyl acrylate and benzyl methacrylate to be readily achieved through plasma polymerization. Indeed, the polymerization of DVTMDS

using a plasma had already been reported. Ex. 1039 at 28; Ex. 1046 at 4-5; Ex. 1020 ¶¶40-43.

177. Legein disclosed acrylates, methacrylates, and organosilanes as preferred classes of compounds to provide protective liquid-repellent coatings on electronics through plasma polymerization. Ex. 1005 at Abstract, 4:22-5:2, 6:10-11, 10:14-26. As I previously noted, a POSA would have known that DVTMDS is an organosilane compound, which were expected to have hydrophobic properties. Ex. 1054 ¶4; Ex. 1045 at 135. And POSA also would have known that benzyl acrylate and benzyl methacrylate are an acrylate and methacrylate, respectively, and would have expected those monomers to have hydrophobic properties as well. Ex. 1056 at 4:24-6:3. Given those teachings from Legein, and Cohen's teachings that copolymers of DVTMDS had similarly beneficial insulating properties for electronics (Ex. 1004 at 5:1-25), a POSA reasonably would have expected that copolymer coatings with protective properties could be successfully applied to electronics through plasma polymerization of DVTMDS with benzyl acrylate or benzyl methacrylate.

2. Claim 2

“A device or component according to claim 1, wherein the protective cross-linked polymeric coating is a physical barrier to mass and electron transport.”

178. Dependent claim 2 requires the coating of claim 1 to be a physical barrier to mass and electron transport. To a POSA, a barrier to electron transport is

something that impedes electrical conductance, often referred to as an electrical insulator (Ex. 1012 at 1:9-18), and that is consistent with the '087 patent's description of the coatings as able to provide electrical insulation. Ex. 1001 at 3:47, 4:11, 4:17-18. Providing electrically insulating coatings on electrical components and devices has long been known and desired to protect such components from short circuits and other electrical damage. Ex. 1048 at 1:10-52, 2:17-35; Ex. 1012 at 7:8-10; Ex. 1018 at 1:6-28; Ex. 1020 at ¶¶ 1-4, 15-16. Similarly, a barrier to mass transport impedes passage of molecules having mass such as liquids and gases, consistent with the '087 patent's discussion of restricting the passage of water, oxygen, and ions. Ex. 1001 at 3:11-20. It was also well known that providing protective coatings for electronics that could restrict passage of such molecules was helpful for preventing corrosion by preventing those molecules from contacting the underlying electronics. Ex. 1014 at ¶¶ 23-24; Ex. 1013 at ¶ 4; Ex. 1048 at 1:50-52; Ex. 1005 at 1:14-17; Ex. 1029 at 6207-08, 6210.

179. A POSA would have found it obvious to use plasma polymer coatings applied using DVTMDS and the compatible benzyl acrylate or benzyl methacrylate monomers taught by Cohen to provide electrically insulating and barrier properties. Cohen taught that such copolymers would function as dielectric (insulating) materials for electrical components and devices. Ex. 1004 at 5:1-25. And it was known that similar copolymer coatings likewise made using organosilanes with acrylates or

methacrylates could protect electrical devices from corrosion. Ex. 1005 at 4:22-5:3; Ex. 1012 at 7:3-21. Moreover, the '087 patent acknowledges that preparing copolymers with the claimed properties was already within a POSA's capabilities and knowledge. Ex. 1001 at 14:30-36 ("The skilled person would understand that the amount will vary to some extent depending on whether the coating is required to be liquid repellent or provide a barrier to mass and electron transport.").

180. In general, a POSA would have expected crosslinking to improve the barrier and insulating properties of such polymer coatings. Ex. 1008 at ¶ 43. Crosslinking was known to yield more amorphous (less crystalline) polymer structure, reducing surface roughness and thus the incidence of grain boundaries forming in the coating. Ex. 1026 at 6550-53. A POSA would have known that the grain boundaries typically present in crystalline and semicrystalline coatings could allow corrosive molecules like oxygen or water vapor to pass. Ex. 1014 at ¶ 36. Consistent with those expectations, a POSA also would have known that the crosslinker DVTMDS had been associated with barrier (Ex. 1017 at 3:27-4:20) and insulating (Ex. 1004 at 5:1-12; Ex. 1018 at 1:6-11, 3:50-4:25; Ex. 1017 at 3:27-4:20; Ex. 1020 at ¶¶ 2, 40) properties when used in polymer coatings.

181. A POSA who desired to prepare a plasma-polymer coating with barrier properties also would have known that, as a basic principle, the ability of a coating to provide insulation and block the passage of contaminants from the environment

typically increases as the thickness of the coating increases. Ex. 1013 at ¶ 39. The POSA would have known that the thickness of a plasma polymer coating can be increased by increasing the polymerization time. Ex. 1005 9:15-17, 28:23-25; Ex. 1006 at 608. It therefore would have been straightforward for a POSA seeking to enhance barrier properties in a copolymer coating to do so by increasing the substrate's plasma exposure time to provide a coating with greater thickness and testing the resulting coatings at various thicknesses to verify that the desired barrier properties had been achieved.

3. Claim 3

“A device or component according to claim 1, wherein the protective cross-linked polymeric coating forms a liquid repellent surface defined by a static water contact angle (WCA) of at least 90°.”

182. Claim 3 specifies that the coating has a static water contact angle (WCA) of at least 90°C. A POSA would have known WCA as a standard metric for measuring the hydrophobicity of a surface. In general, the test is performed by placing a droplet of a liquid, such as water, on a surface to be tested and then measuring the angle formed by the liquid where it contacts the surface, as I've shown below:



183. A POSA would have understood that, generally speaking, the larger the

contact angle, the more liquid-repellent the surface is considered to be. Ex. 1013 at ¶ 41; Ex. 1015 at ¶¶ 11-17, Figs. 1-2; Ex. 1012 at 11:4-11; Ex. 1005 at 12:4-5; Ex. 1029 at 6204-06 and Fig. 19. Thus, a POSA would have concluded that the surface illustrated on the right in the diagram above is more water-repellent than the surface on the left. As a general benchmark, a 90° contact angle was often considered a cutoff between hydrophobic and non-hydrophobic surfaces. Ex. 1001 at 4:28-31 (“A coating with a WCA of at least 90° is a liquid repellent, typically a water repellent layer.”); Ex. 1013 at ¶ 41. A high WCA manifests in the commonly observed phenomenon of water beading on a hydrophobic surface, such as a lotus leaf or a newly waxed finish on a car.

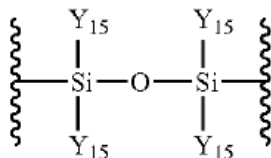
184. Legein disclosed that acrylate, methacrylate, and organosilane compounds were known for producing hydrophobic coatings. Ex. 1005 16:7-14. A POSA would have been aware that the WCAs plasma polymerized films synthesized from DVTMDS were measured to exceed 90°. Ex. 1045 at 135, Fig. 13. A POSA would also have been aware that aryl monomers produced hydrophobic polymers, Ex. 1030 at 802 (Table 1); Ex. 1056 at 4:19-5:3, and would have expected benzyl acrylate and benzyl methacrylate to yield polymers with hydrophobic properties due to the hydrocarbon (benzyl) functional group in each of those monomers. Thus, a POSA would have found it obvious to make copolymer coatings prepared using a hydrophobic aryl acrylate monomer (benzyl acrylate or benzyl methacrylate) and a

hydrophobic crosslinker (DVTMDS), to have a WCA of at least 90°, due to the known hydrophobicity of polymers produced using DVTMDS, benzyl acrylate, or benzyl methacrylate alone. Ex. 1030 at 802; Ex. 1045 at 135, Fig. 13. Achieving the claimed WCA would have been within the knowledge of a POSA, as acknowledged by the '087 patent. Ex. 1001 at 14:34-36 (“The skilled person would understand that the (v/v) percentages are those which give a stable crosslinked polymer coating and the highest water contact angle”); Ex. 1008 at ¶¶ 24-25; Ex. 1004, 2:31-49.

185. The molecular composition of a polymer determines its hydrophobicity. Because benzyl acrylate, benzyl methacrylate, and DVTMDS were known to yield hydrophobic polymers, Ex. 1030 at 802; Ex. 1045 at 135, Fig. 13, it would have been obvious and within the skill of a POSA to combine those reagents to prepare a copolymer with hydrophobic properties, as characterized by a WCA of at least 90°.

4. Claim 5

“A device or component according to claim 1, wherein Y₁₀ has the following formula:



each Y₁₅ is methyl, and each Y₉ is a bond.”

186. As I discussed above with respect to claim 1, the DVTMDS crosslinker disclosed by Cohen contains a formula B1 linker moiety in which each Y₉ is a bond and each Y₁₅ is a methyl group. So claim 5 would have been obvious over the same

prior-art combination as claim 1.

5. Claim 7

“The device or component according to claim 1, wherein the crosslinking reagent is selected from divinyl adipate (DVA), 1,4-butanediol divinyl ether (BDVE), 1,4-cyclohexanedimethanol divinyl ether (CDDE), 1,2,4-trivinylcyclohexane (TVCH), 1,3-divinyltetramethyldisiloxane (DVTMDS), diallyl 1,4-cyclohexanedicarboxylate (DCHD), 1,6-divinylperfluorohexane (DVPFH), 1H,1H,6H,6H-perfluorohexanediol diacrylate (PFHDA) and glyoxal bis (diallyl acetal) (GBDA).”

187. One of the options listed for the crosslinking reagent of claim 7 is DVTMDS. As previously discussed with respect to the obviousness of claim 1, Cohen’s disclosed crosslinking reagent was DVTMDS. Ex. 1004 at 1:25-34. So claim 7 would have been obvious over the same prior-art combination as claim 1.

6. Claim 9

“A device or component according to claim 1, wherein each X is H.”

188. As discussed above, Cohen disclosed the aryl monomers benzyl acrylate and benzyl methacrylate. Benzyl acrylate and benzyl methacrylate include one CX₂ group, where the CX₂ is CH₂. The CH₂ group provides a covalent linkage between the ester group to the six-membered aromatic ring, -C₆H₅. Thus, for the aryl monomers benzyl acrylate and benzyl methacrylate disclosed by the Cohen and Legein combination, each X is H as specified by claim 9. Claim 9 therefore would have been obvious over the same prior-art combination as claim 1.

7. Claims 10

“A device or component according to claim 1, wherein each X is F.”

189. A POSA would have been motivated to use fluoropolymers because of their dielectric nature, inertness to moisture adsorption, and water repellency. Ex. 1029 at 6197. A POSA would have understood that fluorinated coatings were known to confer strong hydrophobicity. Ex. 1029 at 6197; Ex. 1010 at 5:18-23, 10:32-11:1; Ex. 1019 at 2031. And a POSA would have known that water repellency was desirable when making protective coatings for electronics. Ex. 1011 at 4:9-15. A POSA also would have known that modifying the CX₂ group in benzyl acrylate or benzyl methacrylate to CF₂ would result in a single fluorinated carbon, and that compounds with short perfluoroalkyl chains (i.e., 6 carbons or less) do not raise the same safety concerns as other fluorinated monomers. Ex. 1005 at 12:5-12; Ex. 1047 at 100. Thus, POSA would have found it obvious to substitute F for H in the CX₂ group of benzyl acrylate or benzyl methacrylate to improve hydrophobicity in the resulting protective coatings. A POSA would have reasonably expected to succeed in modifying the CX₂ group because preparing a monomer with fluorinated groups was known to the POSA. Ex. 1005 at 16:16-27; Ex. 1011 at 12:1-13:12. A POSA would have been aware that C-F bonds could be used to replace C-H bonds with only minor changes in polymer conformation. Ex. 1029 at 6197.

8. Claim 11

“A device or component according to claim 1, wherein the device or component is selected from a mobile phone, smartphone, pager, radio, sound and audio system, hearing aid, personal audio equipment, television, DVD player including portable a DVD player, video recorder, digi or other set-top boxes, computer or related component, personal digital assistant (PDA), keyboard, instrument, games console, data storage device, outdoor lighting system, radio antennae or other form of communication equipment, or printed circuit board.”

190. As I discussed above with respect to claim 1, Cohen and Legein described polymers for use in applications concerning electronic devices. Legein expressly disclosed that such devices include a mobile phone, a personal digital assistant, and a keyboard. Ex. 1005 at 10:22-26 (“The device may be an electronic (hand held) device such as a mobile phone; a smart phone; a personal digital assistant (PDA); a tablet computer; a loudspeaker; a music player such as an MP3 player; an e-reader; a keyboard; a GPS system; a device used for sport such as a pedometer, heart rate monitor, cadence sensor and the like; a video camera; or a photo camera.”). A POSA would have found it obvious to apply the coatings made by combining Cohen and Legein as set forth for claim 1 to protect devices including at least a mobile phone, a personal digital assistant, or a keyboard.

9. Claim 12

“A device or component according to claim 11, wherein the sound and audio system is a loudspeaker, microphone, ringer and/or buzzer.”

191. As I discussed above with respect to claim 1, Cohen and Legein describe polymers for use in applications concerning electronic devices. Legein

expressly disclosed that such devices include a loudspeaker. Ex. 1005 at 10:22-26 (“The device may be an electronic (hand held) device such as a mobile phone; a smart phone; a personal digital assistant (PDA); a tablet computer; a loudspeaker; a music player such as an MP3 player; an e-reader; a keyboard; a GPS system; a device used for sport such as a pedometer, heart rate monitor, cadence sensor and the like; a video camera; or a photo camera.”). A POSA would have found it obvious to apply the coatings made by combining Cohen and Legein as set forth for claim 1 to protect devices including at least a loudspeaker.

10. Claim 13

“A device or component according to claim 11, wherein the personal audio equipment is a personal CD, tape cassette or MP3 player.”

192. As I discussed above with respect to claim 1, Cohen and Legein describe polymers for use in applications concerning electronic devices. Legein expressly disclosed that such devices include an MP3 player. Ex. 1005 at 10:22-26 (“The device may be an electronic (hand held) device such as a mobile phone; a smart phone; a personal digital assistant (PDA); a tablet computer; a loudspeaker; a music player such as an MP3 player; an e-reader; a keyboard; a GPS system; a device used for sport such as a pedometer, heart rate monitor, cadence sensor and the like; a video camera; or a photo camera.”). A POSA would have found it obvious to apply the coatings made by combining Cohen and Legein as set forth for claim 1 to protect devices including at least an MP3 player.

11. Claim 14

“A device or component according to claim 11, wherein the computer or related component is a laptop, notebook, tablet, phablet or palmtop computer.”

193. As I discussed above with respect to claim 1, Cohen and Legein describe polymers for use in applications concerning electronic devices. Legein expressly disclosed that such devices include a tablet computer. Ex. 1005 at 10:22-26 (“The device may be an electronic (hand held) device such as a mobile phone; a smart phone; a personal digital assistant (PDA); a tablet computer; a loudspeaker; a music player such as an MP3 player; an e-reader; a keyboard; a GPS system; a device used for sport such as a pedometer, heart rate monitor, cadence sensor and the like; a video camera; or a photo camera.”). A POSA would have found it obvious to apply the coatings made by combining Cohen and Legein as set forth for claim 1 to protect devices including at least a tablet computer.

B. Ground 2: Obviousness of claims 1-4, 7, 9, and 11-14 over Francesch and Legein

194. In my opinion, for the reasons explained in more detail below, claims 1-4, 7, 9, and 11-14 of the '087 patent would have been obvious to a POSA in view of Francesch and Legein.

195. In summary, Francesch taught using plasma polymerization to apply a copolymer coating produced from the aryl acrylate monomer pentafluorophenyl methacrylate (PFM) and the crosslinker 1,4-butanediol divinyl ether (BDVE) to a

silicon substrate. Legein taught that plasma-polymer coatings could be used to provide protection for sensitive electronics and electronic devices.

1. Claim 1

[Preamble] “An electronic or electrical device or electronic or electrical component thereof comprising”

196. Legein disclosed “methods of applying surface coatings to articles,” which included “for example the individual components of an electronic (hand held) device.” Ex. 1005 at 1:1-7, *see also* Ex. 1005 at Abstract, 4:5-7, 12:14-19, 20:12-26, 31:8-22. Legein also taught that it was “known to provide an assembled working device with a surface coating in order to protect the device per se against corrosion. For instance, it is known to provide an assembled working mobile phone with a surface coating so that the surface of the mobile phone has water resistant properties.” Ex. 1005 at 1:14-17. Legein taught applying protective coatings to such electronics using plasma polymerization. Ex. 1005 at Abstract, 6:10-11, 8:13-9:27, 11:14-15.

197. In general, by 2015, a POSA was well-aware of the basic desirability and need in the industry to coat electrical devices and their components to protect them from water damage. For example, as referenced above, Legein disclosed that it was known “per se” to treat electronics to provide “water resistant properties” to protect against “corrosion.” Ex. 1005 at 1:14-17. Other references similarly taught the need to protect various electronics from environmental damage. Ex. 1011 at 1:3-3:18, 4:17-5:26; Ex. 2012 at 1:5-2:15.

[Element 1a] “a protective cross-linked polymeric coating on a surface of the device or component; wherein the protective cross-linked polymeric coating is obtained by exposing the device or component to a plasma comprising a monomer compound and a crosslinking reagent for a period of time sufficient to allow formation of the protective cross-linked polymeric coating on a surface thereof,”

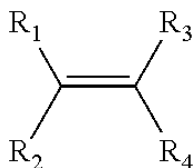
198. Francesch disclosed using plasma polymerization to apply a cross-linked polymer coating to a substrate's surface, where the plasma polymer coating was prepared using a monomer and a crosslinking reagent. Ex. 1006 at 607. For example, Francesch disclosed using plasma polymerization to apply crosslinked polymeric coatings to silicon wafers using the monomer PFM and the crosslinker BDVE. Ex. 1006 at 606-07. Francesch taught plasma deposition times that ranged from 2-8 hours (Ex. 1006 at 607), taught that the thickness of the polymer coatings increased at steady rates over time ($8 \text{ nm} \cdot \text{h}^{-1}$ for the PFM/BDVE copolymer) (Ex. 1006 at 608), and that the resulting coatings were “flat, homogenous surfaces, pin-hole-free” within two hours of deposition time (Ex. 1006 at 609-10).

199. Francesch also disclosed that the resulting coatings were successfully crosslinked with improved durability in terms of solvent resistance. Ex. 1006 at 610 (“The derivatized methacrylate was successfully used as monomer for plasma polymerization alone and copolymerized with different cross-linkers to improve the solvent resistance of the resulting deposited thin films.”). As a POSA would have known, solvent resistance is associated with increased durability of polymer coatings and has long been used in the field as a proxy to demonstrate crosslinking in a

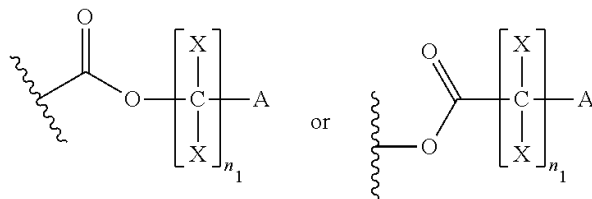
polymer. Ex. 1004 at 3:50-65.

200. Legein disclosed applying protective polymer coatings to electronic devices and components by plasma polymerization for protection against corrosion and liquid damage. *E.g.*, Ex. 1005 at Abstract, 4:22-26, 6:10-11.

[Element 1b] “wherein the monomer compound has the following formula:

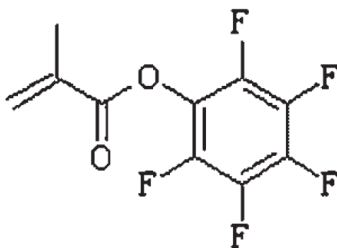


where R₁, R₂ and R₄ are each independently selected from hydrogen, optionally substituted branched or straight chain C₁-C₆ alkyl or halo alkyl or aryl optionally substituted by halo and R₃ is selected from:



where each X is independently selected from hydrogen, a halogen, optionally substituted branched or straight chain C₁-C₆ alkyl, halo alkyl or aryl optionally substituted by halo; where A is aryl optionally substituted by halo; and n₁ is an integer from 0 to 27

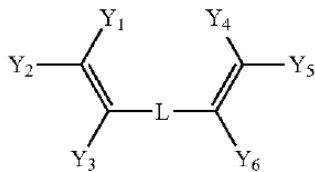
201. Francesch disclosed the claimed monomer. In particular, Francesch disclosed using PFM, which is a fluoro-aryl methacrylate monomer having the following chemical structure:



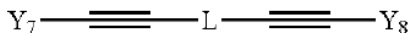
Ex. 1006 at 606. In terms of the structure recited in claim 1, PFM contains a double bond, has hydrogen at the R₁ and R₂ positions, and has a C₁ alkyl (methyl) group at the R₄ position. PFM coincides with the acrylate R₃ structure appearing on the left-hand side in claim 1 (Ex. 1001 at 18:50-55), where n₁ is zero and A is an aryl group (the six-carbon aromatic ring system shown above).

202. Claim 1 recites that the aryl group A may be “optionally substituted by halo.” As can be seen from the structural diagram above, the PFM monomer includes a substituted aryl group with the halogen fluorine (shown as F) substituted for hydrogen at five positions around its aromatic ring, yielding an aryl group known as pentafluorophenyl (–C₆F₅).

[Element 1c] “and wherein the crosslinking reagent comprises two or more unsaturated bonds attached by means of one or more linker moieties and has a boiling point of less than 500° C. at standard pressure, the crosslinking reagent having one of the following structures:



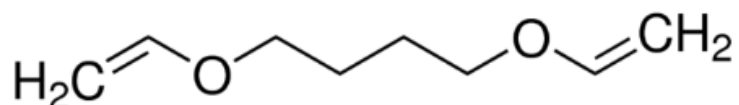
(i)



(ii)

where Y₁, Y₂, Y₃, Y₄, Y₅, Y₆, Y₇ and Y₈ are each independently selected from hydrogen, optionally substituted cyclic, branched or straight chain C₁-C₆ alkyl or aryl; and L is a linker moiety;”

203. Francesch disclosed copolymerizing the PFM monomer with either of two different crosslinking reagents: 1,7-octadiene or 1,4-butanediol divinyl ether (BDVE). Ex. 1006 at 607. As I noted above in the technical background, the structure of BDVE is as follows:



Ex. 1001 at Table 1. BDVE satisfied the structural criteria for the claimed crosslinker compound (i) as set forth in claim 1: both ends of BDVE include double bonds, with each of positions Y₁-Y₆ being hydrogen. The linker moiety, L, for BDVE is -O-CH₂-CH₂-CH₂-O-.

204. The normal boiling point of a reagent is measured at standard pressure and is a fixed physical property of that reagent. The normal boiling point of BDVE is approximately 201°C (verified using chemspider.com, CAS No. 3891-33-6) (Ex. 1050). A POSA in 2015 using standard references would have known or been able to look up the normal boiling point of BDVE. A POSA also would have known how to determine the normal boiling point of BDVE using well known laboratory techniques, such as measuring the temperature of a boiling sample of that reagent at standard (atmospheric) pressure.

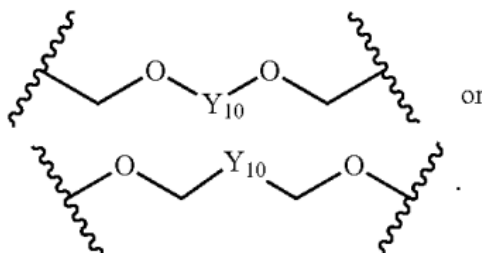
205. A POSA also would have been able to estimate the boiling point of an

organic compound like BDVE. For example, I calculated the normal boiling point of BDVE using a longstanding and widely cited calculation method described by Joback and Reid in 1987. Ex. 1052. In short, knowledge of an organic compound's structure allows accurate estimation of the compound's boiling point based on the component groups that make up its structure: the normal boiling point (in Kelvin) is estimated to equal 198.2 plus the sum of the values assigned to each constituent group in the molecule, as identified in Table 3. Ex. 1052 at 234-38, example calculation at 239. The result in Kelvin can be converted to °C by subtracting 273.15.

BDVE			
<i>Group</i>	<i>Contribution</i>	<i>No.</i>	<i>Total</i>
=CH ₂	18.18	2	36.36
=CH-	24.96	2	49.92
-CH ₂ -	22.88	4	91.52
O nonring	22.42	2	44.84
Total			222.64
Boiling Point (K)			420.84
Boiling Point (°C)			147.69

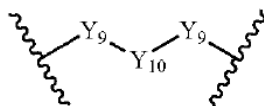
Using the Joback and Reid method, a POSA would have calculated the normal boiling point of BDVE to be approximately 148°C, well below 500°C.

[Element 1d] [Formula A] “wherein for compound (i) L is of formula A having one of the following structures:



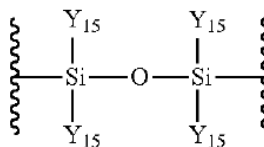
and Y_{10} is selected from optionally substituted cyclic, branched or straight chain C_1 - C_8 alkylene and a siloxane group; or

[Formula B] wherein for compound (i) L is of formula B having the following formula:



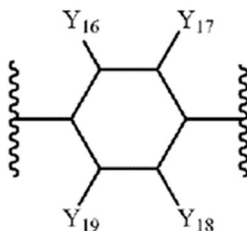
where each Y_9 is independently selected from, a bond, $—O—$, $—O—C(O)—$, $—C(O)—O—$, $—Y_{11}—O—C(O)—$, $—C(O)—O—Y_{11}—$, $—OY_{11}—$, and $Y_{11}O—$, where Y_{11} is an optionally substituted cyclic, branched or straight chain C_1 - C_8 alkylene; and

[Formula B1] wherein Y_{10} has the following formula:



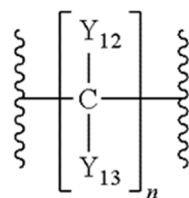
and each Y_{15} is independently selected from optionally substituted branched or straight chain C_1 - C_6 alkyl

or [Formula B2] wherein Y_{10} has the following formula:



and Y₁₆ to Y₁₉ are each independently selected from H and optionally substituted branched or straight chain C₁-C₈ alkyl or alkenyl;

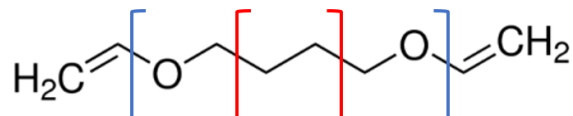
or [Formula B3] wherein Y₁₀ has the following formula:



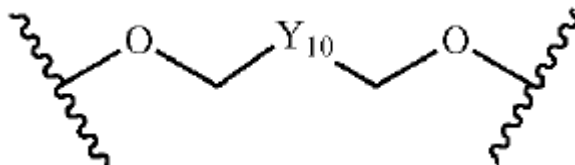
and each Y₁₂ is fluoro and each Y₁₃ is fluoro, and n is an integer from 1 to 10.

206. As can be seen, this limitation of claim 1 recites alternative, generic structural options for the linker moiety of the compound (i) crosslinking reagents. As indicated above, those structures are divided into formula A, which includes two optional structures, and formula B, which provides a third optional structure. As these are alternatives, I understand that only one of the options from either formula A or B needs to be present in the prior art to disclose this limitation. As I discuss above, Francesch disclosed BDVE as a crosslinker, which satisfied the claimed “compound (i).” Furthermore, the linker moiety of BDVE fit within the scope of the “formula A” linker moiety as recited in claim 1.

207. I provide another, marked-up illustration of the structure of BDVE below.



The linker moiety of BDVE, bracketed in blue above, fits the second option for formula A shown in claim 1 (Ex. 1001 at 19:23-25):



where Y_{10} is a straight C_1 - C_8 alkylene chain, specifically the C_2 chain $-CH_2-CH_2-$ as indicated above in red brackets.

a. Motivation to combine

208. In my opinion, a POSA would have been motivated to combine the teachings of Francesch and Legein to arrive at an electronic device bearing a protective polymer coating as recited in claim 1 of the '087 patent. Legein made clear the need to provide protective coatings for electronics, which was well known in the field by 2015. Ex. 1005 at 1:1-17, 4:22-26, 6:10-11; Ex. 1011 at 1:3-2:17. Legein also called for preparing such protective coatings using methacrylate monomers, a class of monomers that includes PFM. Ex. 1005 at 4:22-5:2 (listing methacrylates), 10:14-26 (same). Francesch taught crosslinked polymer coatings made from PFM and BDVE that were successfully applied to silicon wafer substrates by plasma polymerization under "easy reaction conditions." Ex. 1006 at 607, 609-11. A POSA seeking to use plasma polymer coatings for protecting electronics, in view of Legein,

would have been motivated to use Francesch's polymer coatings to do so because a POSA would have understood that Francesch's polymer coatings were crosslinked, had hydrophobic properties, had been demonstrated to be suitable for plasma-mediated deposition, and had been successfully applied onto silicon wafer substrates, which are common substrates found in many electronics.

209. A POSA would have been motivated to use Francesch's copolymer coatings to protect electronics because those coatings were crosslinked. Francesch at 607. As previously noted, a POSA would have understood that crosslinking can improve the strength, durability, and solvent resistance of polymer coatings, which a POSA would have found desirable as applied to personal electronic devices subjected to years of daily use under a range of environmental conditions. Ex. 1010 at 4:4:1-27; Ex. 1008 at ¶ 46; Ex. 1004 at 3:58-65 (noting the increased solvent resistance associated with crosslinking); Ex. 1006 at 610 (noting that PFM was "copolymerized with different cross-linkers to improve the solvent resistance of the resulting deposited thin films"). A POSA also would have associated crosslinking with improved barrier properties against water or gas infiltration. It was known that crosslinking results in more amorphous (less crystalline) polymer films, Ex. 1014 at ¶ 39; Ex. 1026 at 6551, which was known to reduce surface roughness and thus the likelihood of grain boundary formation in the coating, Ex. 1026 at 6550-53. That is

consistent with Francesch's data showing low surface roughness for the disclosed crosslinked polymer coatings. Ex. 1006 at Fig. 3.

210. A POSA would have recognized PFM as a bifunctional monomer capable of mediating additional crosslinking on its own due to its two unsaturated sites: its acrylate double bond and its unsaturated aryl ring. Ex. 1008 at ¶ 24.

211. A POSA also would have been motivated to use Francesch's copolymer coatings due to the known hydrophobic properties associated with polymers prepared using fluorinated monomers in general and PFM in particular. Monomers containing fluorocarbon groups were known to confer effective hydrophobic properties on polymers produced from such monomers, including when prepared using plasma polymerization. Ex. 1005 at 11:14-12:12; Ex. 1010 at 5:18-23, 10:32-11:1; Ex. 1019 at 2031; Ex. 1011 at 11:1-16; Ex. 1026 at 6553; Ex. 1029 at 6197, 6204-05. In addition, a POSA would have known that PFM in particular was recognized in the field as a hydrophobic monomer useful for preparing hydrophobic polymers and copolymers. Ex. 1008 at ¶ 21; Ex. 1009 at 12896-97, Fig. 3. A POSA also would have been motivated to use Francesch's PFM-based copolymers to make protective coatings for electronics because it was known that aryl groups like the one in PFM promoted water repellency due to surface packing and bulkiness of fluorinated aromatic rings in the finished polymer. Ex. 1029 at 6206.

212. A POSA further would have been motivated to adopt Francesch's copolymer coatings for use applying protective coatings to electronics as in Legein because Legein called for preferably applying such coatings by plasma polymerization. Ex. 1005 at Abstract, 6:10-11, 11:14-15, 21:20-22:2. Francesch demonstrated that the disclosed PFM-based, crosslinked copolymer coatings could likewise be applied using plasma deposition, Ex. 1006 at 606-07, using "easy reaction conditions," Ex. 1006 at 610. A POSA therefore would have viewed Francesch's coatings as compatible with Legein's teachings and offering the same benefits associated with application to electronics through plasma polymerization as a dry, efficient coating technique able to reach internal surfaces of electronic substrates and provide uniform conformal coatings on substrates (like many electronics) that have complex surface geometries. Ex. 1006 at 606; Ex. 1012 at 8:1-4, 8:15-21, 15:15-20, 16:20-24; Ex. 1010 at 2:10-14; Ex. 1005 at 4:1-3.

213. In addition, a POSA would have been motivated to use Francesch's PFM-based polymer coatings to protect electronics because Francesch had already shown that those coatings could be successfully applied onto silicon wafers, Ex. 1006 at 607, which are common substrates found in many electronics.

214. Finally, a POSA would have found it obvious to use the disclosed cross-linked copolymer made using PFM specifically with BDVE because Francesch disclosed only two options, BDVE or 1,7-octadiene, as crosslinkers for PFM. Ex. 1006

at 607, 608-10. Francesch taught that both disclosed crosslinkers successfully produced crosslinked copolymer coatings under plasma conditions. Ex. 1006 at 608-10. A POSA would have found it obvious to use BDVE as one of only two identified crosslinkers for use with PFM.

215. In addition, in my opinion and experience, a POSA also would have preferred to use BDVE over 1,7-octadiene for the practical reason that BDVE has a boiling point that is much closer than that of 1,7-octadiene to the boiling point of PFM. The normal boiling point of PFM is approximately 239°C (verified using chemspider.com, CAS No. 13642-97-2) (Ex. 1051). The normal boiling point of 1,7-octadiene is approximately 115°C (Ex. 1006 at 607), and as noted above, the normal boiling point of BDVE is approximately 201°C (Ex. 1050). As a result, a POSA would have preferred to use BDVE with PFM in a plasma copolymerization because it would have been simpler to identify and set an input temperature that would vaporize both compounds to a similar vapor pressure to feed the plasma chamber during a coating operation.

b. Reasonable expectation of success

216. A POSA would have had a reasonable expectation of success in combining Francesch and Legein in the manner claimed in claim 1, because they involve little more than applying polymers and techniques in manners that were well understood in the field. Plasma polymerization was well-understood and routine to

POSA's before June 2015. *See, e.g.*, Ex. 1010 at 2:10-13 ("Plasma deposition techniques have been quite widely used for the deposition of polymeric coatings onto a range of surfaces."), 10:8-12 ("routine methods"). Even the '087 patent acknowledges that determining conditions for plasma deposition on electronics were routine for a POSA, stating that "the precise conditions under which the protective polymeric coating is formed can be determined using routine methods." Ex. 1001 at 14:66-15:5.

217. A POSA would have expected the PFM/BDVE copolymer disclosed by Francesch to work on electronic devices. For example, Francesch disclosed successfully using those compounds together to apply coatings through plasma polymerization on silicon wafers, which resemble the hard, silicon-containing surfaces of many electronic devices and components. Ex. 1006 at 606-07. Given the known versatility of plasma polymerization to apply coatings to essentially any solid surface, a POSA would have expected Francesch's disclosed plasma-based coating methods to be applicable to electronic devices as well. Furthermore, a POSA also would have reasonably expected that Francesch's PFM-based polymer coating would protect electronics against water damage because Legein taught that methacrylate monomers were among the three preferred types of monomers for producing protective, water-repellent coatings, and PFM is a methacrylate monomer. Ex. 1005 at 11:14-12:12, 16:7-27. In addition, a POSA would have expected that PFM could successfully be used

to produce water-repellent polymer coatings due to its fluorinated aryl group and the long-recognized hydrophobicity of fluorinated organic monomers. Ex. 1008 at ¶¶ 21, 24; Ex. 1009 at 12896-97, Fig. 3; Ex. 1010 at 5:18-23, 10:32-11:1; Ex. 1019 at 2031; Ex. 1011 at 11:1-16; Ex. 1026 at 6553; Ex. 1029 at 6197, 6204-06.

218. In addition, a POSA would have reasonably expected to achieve hydrophobic polymer coatings with PFM when including BDVE as a crosslinker because it was known in the art to adjust the proportion of hydrophobic monomer in a copolymer composition relative to the proportion of crosslinker as needed to achieve a desired level of hydrophobicity in the resulting polymer. Ex. 1008 at ¶ 25. Such adjustments to the relative amounts of PFM and BDVE used during plasma polymerization would have been routine for a POSA. In addition, the POSA would have expected the known crosslinking ability of PFM, Ex. 1008 ¶ 24, to at least partially offset any reductions in crosslinking associated with reducing the proportion of BDVE in the copolymer composition.

219. Accordingly, a POSA would have had a reasonable expectation of success in combining the teachings of Francesch and Legein as recited in claim 1.

2. Claim 2

“A device or component according to claim 1, wherein the protective cross-linked polymeric coating is a physical barrier to mass and electron transport.”

220. A POSA would have found it obvious to prepare coatings with barrier properties using Francesch’s combination of PFM and BDVE. For example, a POSA would have expected those coatings to have hydrophobic properties due to the fluorinated aryl ring of the PFM. PFM is a fluorinated methacrylate monomer, and other fluorinated acrylate and methacrylate monomers had been widely used and valued for their barrier properties long before 2015. Ex. 1012 at 7:3-21, 13:3-14; Ex. 1005 at 4:22-55, 16:7-27. Furthermore, a POSA would have expected the crosslinking mediated by BDVE to improve the barrier properties of the polymer coatings by reducing crystallinity and the associated likelihood of channels formed in the grain boundaries for molecules or electrical conductance through the coatings—crosslinking tends to make polymer films amorphous. Ex. 1014 at ¶ 39; Ex. 1026 at 6551. Accordingly, a POSA would have found it obvious to prepare coatings on electronics with the physical barrier properties of claim 2 through the combination of Francesch and Legein.

221. Moreover, the ’087 patent acknowledges that adjusting the amounts of specific monomers and crosslinkers in a given plasma polymer composition to achieve physical barrier properties was already within a POSA’s capabilities and

knowledge. Ex. 1001 at 14:30-36 (“The skilled person would understand that the amount will vary to some extent depending on whether the coating is required to be liquid repellent or provide a barrier to mass and electron transport.”). In particular a POSA would have known that increasing a coating’s thickness will improve its barrier properties. Ex. 1014 at ¶ 21; Ex. 1013 at ¶ 39. A POSA would have understood that the plasma deposition process can be controlled to facilitate physical barrier properties as needed to suit a particular application. Ex. 1005 at 9:15-17 (“The longer the polymerisation time the thicker the resultant polymer coating. Therefore, the choice of polymerisation time and hence coating thickness depends to a certain degree on the use or application of the component being coated”); Ex. 1005 at 28:23-25. And a POSA would have known how to control the thickness of a PFM/BDVE coating by adjusting the coating time. Ex. 1006 at 608. The barrier properties recited in claim 2 thus would have been expected and obvious for a POSA to achieve using PFM, BDVE, and plasma polymerization as taught by Francesch and Legein.

3. Claim 3

“A device or component according to claim 1, wherein the protective cross-linked polymeric coating forms a liquid repellent surface defined by a static water contact angle (WCA) of at least 90°.”

222. A POSA would have known that the molecular composition at the surface of a copolymer determines its hydrophobicity. Ex. 1043 at 63. A POSA would have been aware that low surface tension drives the preferential migration of

fluorine-containing groups to the surface of a polymer film. Ex. 1029 at 6209; Ex. 1026 at 6548. As discussed above with respect to claim 1, PFM monomers were known to have hydrophobic properties due to the fluorinated aryl ring of the PFM. A POSA would have expected that the PFM unit would segregate to the surface of a finished PFM/BDVE copolymer film preferentially over the nonfluorinated BDVE molecule. And a POSA would have found it to be obvious and expected to prepare such coatings having a PFM-rich copolymer surface that would yield a water contact angle of at least 90°. And I agree with the authors of the '087 patent that it would have been within the skills of a POSA to adjust the relative amounts of monomer and crosslinker in Francesch's PFM/BDVE combination to achieve a desired level of water repellency, such as a water contact angle of 90° or greater. Ex. 1001 at 14:26-36; Ex. 1008 at ¶¶ 24-25.

4. Claim 4

“A device or component according to claim 1, wherein n is from 4 to 6.”

223. The additional limitation in claim 4 specifies a crosslinker containing a perfluoroalkyl chain in its linker moiety, with a length of between four and six CF₂ groups. A POSA seeking to further increase or optimize the hydrophobicity in a protective coating resulting from the combination of Francesch and Legein would have been motivated modify the unsubstituted structure of the BDVE crosslinker to introduce a short, hydrophobic C₄F₈ fluorinated group to replace the original C₄H₈

hydrocarbon chain in the BDVE linker moiety. As discussed, fluorinated hydrocarbons were well known to exhibit strong hydrophobicity, and it was routine for POSAs in this field to substitute hydrocarbon groups with fluorocarbon groups for synthesizing polymers. Ex. 1029 at 6197. A POSA would have expected that including a fluoro-substituted linker moiety in BDVE would increase the hydrophobicity of the crosslinker and, as a result, also increase the hydrophobicity of the resulting copolymer prepared using PFM and the substituted version of BDVE. That would in turn have been expected to provide even better protection against water for coated electronics.

224. Making that substitution, the crosslinker would have matched the structure of compound (i), formula B3 of claim 1. The substituted crosslinker would contain two double bonds separated by a linker moiety (consistent with compound (i)) and hydrogen at positions Y_1 - Y_6 . In addition, the substituted crosslinker would have each Y_9 as oxygen (—O—) and Y_{10} as a fluorocarbon chain in which each Y_{12} and Y_{13} are fluoro and n is between 1 and 10 (in this case, four). Ex. 1001 at 19:1-43, 20:1-11. That substituted crosslinker structure also would have satisfied the additional limitation of claim 4, because the number (n) of fluorocarbon (CF_2) groups in the substituted linker moiety would be equal to four. Accordingly, claim 4 would have been obvious to one of ordinary skill in the art in view of Francesch, Legein, and the level of skill in the art.

5. Claim 7

“The device or component according to claim 1, wherein the crosslinking reagent is selected from divinyl adipate (DVA), 1,4-butanediol divinyl ether (BDVE), 1,4-cyclohexanedimethanol divinyl ether (CDDE), 1,2,4-trivinylcyclohexane (TVCH), 1,3-divinyltetramethyldisiloxane (DVTMDS), diallyl 1,4-cyclohexanedicarboxylate (DCHD), 1,6-divinylperfluorohexane (DVPFH), 1H,1H,6H,6H-perfluorohexanediol diacrylate (PFHDA) and glyoxal bis (diallyl acetal) (GBDA).”

225. One of the options listed for the crosslinking reagent of claim 7 is BDVE. As previously discussed with respect to the obviousness of claim 1, Francesch expressly described using BDVE as a crosslinking reagent in combination with PFM.

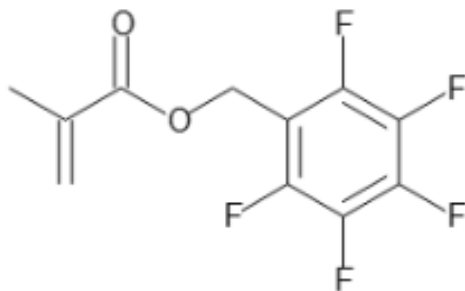
6. Claim 9

“A device or component according to claim 1, wherein each X is H.”

226. Claim 9 would have been obvious to a POSA. A POSA would have known including a hydrocarbon (CH_2) spacer of $n = 1$ between the acrylate group and the aryl group would have increased the flexibility of the corresponding polymer. Ex. 1035 at 719. For example, benzyl methacrylate, which has just a single CH_2 group between its acrylate and aryl groups, allows a substantial increase in rotational mobility in the main chain of the corresponding polymer. A more flexible polymer increases the ability of the aryl groups to interact with each other. Ex. 1035 at 719. Such interactions between the aryl functional groups would lead to a denser polymer. And a POSA would have expected that a higher density barrier layer would provide

even more robust protection against the ingress of water. Ex. 1014 at ¶ 34.

227. A POSA therefore would have been motivated to add at least one CH₂ spacer to the PFM monomer disclosed by Francesch to generate a crosslinked polymer having increased flexibility to allow for favorable interactions between the aryl groups in the resulting polymer, which would improve the water barrier properties of the finished polymer coating. Those would have been straightforward chemical modifications for a POSA to make to PFM, so a POSA would have reasonably expect to succeed in doing so. Adding one –CH₂– spacer to PFM results in the monomer pentafluorobenzyl methacrylate (PFBM) (CAS No. 114859-23-3), which I have illustrated below:



A POSA also would have known that PFBM is a hydrophobic, polymerizable monomer capable of producing water-repellent copolymers. Ex. 1008 at ¶¶ 23-24. In addition, it would have been straightforward for a POSA to obtain and use PFBM because that compound was commercially available before 2015. Ex. 1008 at ¶ 76. Thus, a POSA would have been motivated to utilize plasma polymerization to prepare protective polymer coatings on electronics using BDVE and the PFBM, which

is closely related to PFM, based on Francesch, Legein, and the skill and knowledge of a POSA and would have reasonably expected to succeed in doing so.

228. Accordingly, claim 9 would have been obvious for that additional reason.

7. Claims 11-14

11: “A device or component according to claim 1, wherein the device or component is selected from a mobile phone, smartphone, pager, radio, sound and audio system, hearing aid, personal audio equipment, television, DVD player including portable a DVD player, video recorder, digi or other set-top boxes, computer or related component, personal digital assistant (PDA), keyboard, instrument, games console, data storage device, outdoor lighting system, radio antennae or other form of communication equipment, or printed circuit board.”

12: “A device or component according to claim 11, wherein the sound and audio system is a loudspeaker, microphone, ringer and/or buzzer.”

13: “A device or component according to claim 11, wherein the personal audio equipment is a personal CD, tape cassette or MP3 player.”

14: “A device or component according to claim 11, wherein the computer or related component is a laptop, notebook, tablet, phablet or palmtop computer.”

229. Legein disclosed applying protective polymer coatings to electronic devices including a mobile phone (claim 11), a personal digital assistant (claim 11), a keyboard (claim 11), a loudspeaker (claims 11, 12), and MP3 player (claims 11, 13), and a tablet computer (claims 11, 14):

The device may be an electronic (hand held) device such as a **mobile phone**; a smart phone; a **personal digital assistant (PDA)**; a **tablet computer**; a **loudspeaker**; a

music player such as an **MP3 player**; an e-reader; a keyboard; a GPS system; a device used for sport such as a pedometer, heart rate monitor, cadence sensor and the like; a video camera; or a photo camera.

Ex. 1005 at 10:22-26 (emphasis added).

230. Thus, Legein disclosed the electronic devices or components of claims 11-14, and it would have been obvious to apply the protective coatings described above to those specific types of electronics over the combination of Francesch and Legein for the same reasons as set forth for claim 1.

I hereby declare that all the statements made in this declaration are of my own knowledge and true; that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I declare under the penalty of perjury that all statements made in this declaration are true and correct.

Date: 1/2/2021

A handwritten signature in black ink, appearing to read 'Karen K. Gleason', written over a horizontal line.

Karen K. Gleason, Ph.D.