

**UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW JERSEY**

**RENSELAER POLYTECHNIC
INSTITUTE,**

Plaintiff,

v.

**SAMSUNG ELECTRONICS AMERICA,
INC. and SAMSUNG ELECTRONICS
CO., LTD.,**

Defendants.

Civ. No. 19-20097 (KM) (ESK)

OPINION & ORDER

(*Markman* Claim Construction)

KEVIN MCNULTY, U.S.D.J.:

This Opinion contains the Court’s construction of key patent terms following a *Markman* hearing.¹ This patent infringement case is brought by Rensselaer Polytechnic Institute (RPI) against defendants Samsung Electronics America, Inc., and Samsung Electronics Co., Ltd. (collectively, “Samsung”). The patents-in-suit are Patent Nos. 6,906,339 (“the ’339 Patent”) and 7,253,119 (“the ’119 Patent”). These patents describe a method for manufacturing semiconductor nanoparticles, also known as “quantum dots,” used in optical and electronic applications, including television displays. In approximately 2015, Samsung began manufacturing television sets with “quantum dots” which are alleged by RPI to violate the asserted patents. Accordingly, RPI brought this infringement suit against Samsung in November 2019. I held a *Markman* hearing in October 2021.

I. BACKGROUND

The two patents at issue—the ’339 patent and the ’119 patent—concern a method of synthesizing semiconductor nanoparticles (or “quantum dots”) for use in optical and electronic applications. (DE 1 ¶¶ 8-11; ’399 Patent 1:15–20;

¹ The reference is to *Markman v. Westview Instruments, Inc.*, 517 U.S. 370 (1996).

'119 Patent Abstract, 1:18-23.)² The patented method of synthesizing these particles uses “elemental passivation,” a process that can prevent or discourage such nanoparticles from “agglomerating,” that is, sticking together. ('339 Patent Abstract, 3:25-39, 3:60-63; '119 Patent 3:30-44, 3:45-65.) This method was intended to be an improvement over the existing method of synthesizing nanoparticles with “shells,” a structure referred to as “core-shell architecture,” because such shelled nanoparticles were difficult to manufacture and performed poorly. ('339 Patent 1:21-58, 3:40-57; '119 Patent 1:24-60.) Instead, the patented process of “elemental passivation” involves the binding of chemical elements (called “dangling bonds”) to parts of the nanoparticle’s surface to prevent agglomeration. ('339 Patent Abstract, 2:55-62, 3:25-39, 4:42-62; '119 Patent 3:30-44, 3:45-65.) The synthesis of these particles comprises two major steps: the first step, in which nanoparticles are formed in an aqueous solution, and the second in which a chemical agent “etches” the nanoparticles to a desired size. ('339 Patent Abstract, 2:49-54, 3:64-4:10, 20:16-31; '119 Patent 2:54-59.) Information gleaned from photon correlated spectroscopy (“PCS”) is used to determine that the nanoparticles are of the

² Certain citations to the record are abbreviated as follows:

DE = docket entry

RPI Opening Br. = RPI’s Opening Claim Construction Brief (DE 95)

Samsung Opening Br. = Samsung’s Opening Claim Construction Brief (DE 94)

RPI Resp. Br. = RPI’s Response Brief (DE 99)

Samsung Resp. Br. = Teva’s Response Brief (DE 100)

'339 Patent = Patent No. 6,906,339 (DE 1-1)

'119 Patent = Patent No. 7,253,119 (DE 1-2)

Fahlman Decl. = Declaration of Bradley Fahlman, Ph.D. (DE 94-1)

Green Decl. = Declaration of Mark Green, Ph.D. (DE 94-2)

Reisberg Decl. = Declaration of Joshua S. Reisberg. (DE 94-3)

Palomaki Decl. = Declaration of Peter K. B. Palomaki, Ph.D. (DE 95-1.)

Hrg Tr. = Transcript of *Markman* hearing held on October 19, 2021 (DE 111)

correct size and are not agglomerating. (‘339 Patent 2:43-48, 17:3-24, 20:63-21:11; ‘119 Patent 1:61-2:53.)

The ‘339 patent and the ‘119 patent were developed and invented by RPI’s Dr. Partha Dutta and were issued by the U.S. Patent Office in 2005 and 2007. (DE 1 ¶¶ 8-11.) At least as early as 2015, Samsung began manufacturing “QLED” televisions using “quantum dot” semiconductor nanoparticles, products that RPI alleges infringed these patents by employing elementally passivated nanoparticles to make the television display screens. (See DE 1 ¶¶ 12-34.) RPI filed suit against Samsung on November 19, 2021. (DE 1.)

Following relevant discovery, the parties presented their dispute as to the meaning of certain claims. On October 19, 2021, I convened a Markman claim-construction hearing. (Hrg Tr.) What follows is my ruling as to the construction of the disputed claims.

II. STANDARD

A patent infringement case involves two steps. First, the court determines the meaning of claims in the patent. *Amgen Inc. v. Amneal Pharms. LLC*, 945 F.3d 1368, 1375 (Fed. Cir. 2020). Second, the court compares the claims, as construed, to the allegedly infringing product. *Id.*

We are now concerned with the first step, known as claim construction. When, as here, the parties dispute the meaning of the patent’s claims, the court must resolve those disputes. *Bayer Healthcare LLC v. Baxalta Inc.*, 989 F.3d 964, 977 (Fed. Cir. 2021). This task primarily requires construal of written documents (quintessentially, the patent itself), but some factual determinations may be needed to assist in understanding the written words. *Teva Pharms. USA, Inc. v. Sandoz, Inc.*, 574 U.S. 318, 325–26 (2015). Accordingly, there is a hierarchy of sources to be considered when construing a claim, arranged in decreasing order of importance. *Profectus Tech. LLC v. Huawei Techs. Co.*, 823 F.3d 1375, 1381 (Fed. Cir. 2016).

Of course, I “begin with the words of the claims themselves.” *Allergan Sales, LLC v. Sandoz, Inc.*, 935 F.3d 1370, 1373 (Fed. Cir. 2019) (citation

omitted). Those words receive the meaning “a person of ordinary skill in the art” (“POSA”) would give them. *Id.* (citation omitted). A POSA would interpret those words in the context of the rest of the patent document, including the specification which describes the invention. *Id.* at 1373 & n.6.

The prosecution history, *i.e.*, proceedings before the U.S. Patent and Trademark Office that led to approval of the patent, can further illuminate a term. *Id.* at 1373 & n.7.

The foregoing items constitutes “intrinsic evidence,” *i.e.*, evidence from within the patent process itself. I may also turn to “extrinsic evidence,” or evidence outside the patent and prosecution history. *Id.* at 1373 & n.8. Such extrinsic evidence includes “expert and inventor testimony, dictionaries, and learned treatises.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1317 (Fed. Cir. 2005) (en banc). Such extrinsic evidence is second-priority; it cannot “trump the persuasive intrinsic evidence.” *Immunex Corp. v. Sanofi-Aventis U.S. LLC*, 977 F.3d 1212, 1221–22 (Fed. Cir. 2020) (citation omitted).

III. DISCUSSION

The parties have identified nine claim terms whose meaning are in dispute. I discuss them in sections III.A–C.

A. Structure and Characterization Terms

1. “nanoparticle”

Term	RPI’s Construction	Samsung’s Construction
“nanoparticle” (All asserted claims.)	a nanoscale particle	a nanoscale particle that does not have any shells

Foundational to both the asserted patents and the dispute before me is the term “nanoparticle,” a word that the parties agree refers to a “nanoscale particle,” *i.e.*, a particle with an approximate diameter between 2 and 100 nanometers. Their disagreements arise over whether the term includes

nanoparticles with “shells” or only those without shells. (RPI Opening Br. at 12; Samsung Opening Br. at 3-4.) RPI argues that the ordinary meaning of the term “nanoparticle” is a broad one, encompassing nanoscale particles both with and without shells, as evidenced by prior art and the patentee’s failure to “disavow shelled nanoparticles from the term nanoparticle” in any of the asserted patents. (RPI Opening Br. at 12-13.) Samsung counters that the term “nanoparticle” excludes nanoscale particles with shells because (1) evidence such as the patentee’s testimony during prosecution and the language of the patent itself “disparages” nanoparticles with shells; and (2) the size of a nanoscale particle with a shell cannot be measured by PCS, as directed by the ’339 patent. (Samsung Opening Br. at 3-9.)

Reviewing the language of the asserted patents, I ultimately agree with Samsung that the term “nanoparticle” refers to a nanoscale particle without a shell. Indeed, the asserted patents have at their core a distinction between nanoparticles with elementally passivated surfaces and prior-art nanoparticles with core-shell architecture. (*See, e.g.*, ’339 patent, 1:21-58 (describing how core-shell nanoparticles are “disadvantageous” compared to elementally passivated nanoparticles), 3:41-57 (noting that “a true or ‘elemental’ passivated surface should be distinguished from formation of a semiconductor or organic surfactant shell around a nanoparticle of the prior art”), 3:64-4:10 (noting how elemental passivation allows for greater control over nanoparticle size than prior art utilizing shells); ’119 Patent 1:24-60 (describing how core-shell nanoparticles are “disadvantageous” compared to elementally passivated nanoparticles.) The patents’ distinction between elementally passivated and shelled nanoparticles has two implications important here: that the patents are inherently concerned with nanoparticles without shells, and that the patents refer to nanoscale particles and any shells they may possess separately and distinctly, rather than placing both under the umbrella term of “nanoparticle.” (*See, e.g.*, ’319 Patent 3:54-57 (“[N]anoparticles coated in a shell are not elementally passivated because an organic or inorganic compound is formed on the nanoparticle, rather than a passivating element which is bound to the

dangling bonds.”); *see also* Reisberg Decl. Ex. K at 11-13; Green Decl. ¶¶ 31-36.) Reinforcing this evidence is the patentee’s statement during the prosecution of the related European patent that the “core-shell structure is at least one aspect [of the prior art nanoparticles] the present inventors wanted to avoid when they developed the presently claimed invention.” (Reisberg Decl. Ex. L at 3; (“an elementally passivated nanoparticle and a core-shell nanoparticle have different chemistry and mechanisms of passivation.”))

Another key contextual clue is that interpreting the term “nanoparticle” to include nanoparticles with shells would make measuring the size of the nanoparticles by PCS, as required by the asserted patents, impossible. (See Fahlman Decl. ¶ 23.) PCS instruments measure only a particle’s “hydrodynamic diameter,” a measurement approximately of the outermost diameter of the entire particle structure. It follows that if a particle has a shell, PCS instruments could only measure the outermost diameter of that shell, rather than the particle inside. (*Id.*) The patents’ concern for reducing nanoparticle agglomeration can only be vindicated if the nanoparticles subject to elemental passivation lack shells.

Accordingly, in view of the intrinsic evidence and particularly the patent language itself, I agree with Samsung that the term nanoparticle refers to a nanoscale particle without a shell unless expressly indicated otherwise.

2. “nanoparticles [having/have] an average size between [X] with a size standard deviation of [Y] of the average nanoparticle size determined by photon correlated spectroscopy (PCS) method”

Term	RPI’s Construction	Samsung’s Construction
“nanoparticles [having /have] an average size between [X] with a size standard deviation of [Y] of the average nanoparticle size determined by photon correlated spectroscopy (PCS)” (‘339 patent, all asserted claims.)	nanoparticles [having/have] an average hydrodynamic diameter between [X], with a standard deviation of [Y], which would be consistent with the weight% distribution generated by an analysis by photon correlated spectroscopy (PCS).	nanoparticles [having/have] an average hydrodynamic diameter between [X] with a standard deviation of [Y] as measured by photon correlated spectroscopy (PCS) method

The asserted patents instruct that the average size and standard deviation of a sample of nanoparticles must be “determined by [PCS],” a phrase that the parties now dispute. Although the parties agree that the “average size” of a nanoparticle refers to its hydrodynamic diameter, they disagree as to what “determined by [PCS]” actually entails. (RPI Opening Br. at 14; Samsung Opening Br. at 10-11, 11 n.7.)

RPI argues that the average size of a nanoparticle “determined by [PCS]” refers to PCS data presented in the “weight% distribution” mode of analysis. (RPI Opening Br. at 15.) RPI explains that the ‘339 patent only describes the use of PCS on nanoparticle related to the invention according to weight%. That weight% to PCS data, says RPI, is known to yield “more accurate size and standard deviation measurement[s]” than alternatives such as the intensity% mode of analysis. (*Id.* at 15-16.) Moreover, RPI urges that infringement of the ‘339 patent does not require the performance of a PCS test to determine nanoparticles’ average size and standard deviation because these are “physical characteristics” of nanoparticles and may be established through other “consistent and reliable information.” (*Id.* at 17-18.)

Samsung responds that the plain meaning of “determined by [PCS]” encompasses “multiple, different types of measurement techniques using a PCS instrument,” and is not limited solely to measurement according to weight% distribution. (Samsung Opening Br. at 11-12.) Indeed, Samsung maintains that both the weight% and intensity% modes of analysis were valid methodologies for determining nanoparticle size at the time the ‘339 patent was written, and notes that the asserted patents cite intensity% PCS measurements in describing prior art while using weight% in describing the size information of the patent’s preferred embodiments. (*Id.* at 11-12.) Finally, Samsung argues that RPI’s attempt to use non-PCS methodologies to show infringement of the ‘339 patent is improper because (1) PCS is the sole relevant methodology identified by the ‘339 patent; (2) determining whether a different methodology is as “consistent and reliable” as PCS would add ambiguity to the ‘339 patent; and (3) RPI’s prior arguments to this Court suggested that a weight% mode of PCS analysis is the only method of determining size and standard deviation contemplated by the asserted patents. (*Id.* at 13-15.)

First, I must agree with Samsung that the most natural reading of “determined by [PCS]” is that information regarding the size of nanoparticles must be derived from a PCS measurement, and not from some other, unspecified methodology that is purportedly equivalent. (*See* Fahlman Decl. ¶ 33.) The ‘339 patent dictates a PCS specification for measuring size, differentiating it from other common techniques for measuring nanoparticles, such as transmission electron microscopy (“TEM”) and optical spectroscopy. (‘339 patent 1:59-2:37 (“[S]ince very few nanoparticles are observed during each [TEM] test, the nanoparticle size varies greatly between observations of different nanoparticles from the same solution. . . . [Optical spectroscopy] does not show whether the individual nanoparticles in a solution are agglomerated into a large cluster.”; ‘119 patent 2:3-41 (same).) Moreover, the language of the patent does not reveal any clear metric by which a POSA could gauge whether a non-PCS methodology for measuring nanoparticle size is of equivalent consistency and reliability. *See E-Pass Techs., Inc. v. 3Com Corp.*, 473 F.3d

1213, 1220 (Fed. Cir. 2007) (“the terms courts use to enunciate the proper construction of a claim are not themselves limitations that require interpretation”). RPI itself has provided no such metric, and its prior filings seemingly concede that “the claims at issue in the ‘339 patent explicitly identify a single method of measurement: photon correlated spectroscopy.” (ECF No. 67 at 2-3.)

Second, the intrinsic evidence before me does not support RPI’s limitation of looking solely to the weight% distribution mode of PCS analysis to determine nanoparticles’ size. The patents’ inventor relied on two different PCS measurement techniques to demonstrate that the patented nanoparticles were superior to prior art, reporting size information using weight% for the preferred embodiments (‘339 patent at 4-5, Figures 7-11), while reporting size information using intensity% for the prior art examples (*id.* at 6, Figures 12-15). (See also Fahlman Decl. ¶¶ 26, 35-36 (noting that the PCS instrument specified in the ‘339 patent uses both the Intensity% and Weight% methodologies when measuring nanoparticles).) Moreover, using both intensity% and weight% here appears appropriate given that both were considered valid PCS methodologies for measuring average size and size distribution of nanoparticles at the time the ‘339 patent was written. (Fahlman Decl. ¶¶ 27-29, 36-37 (explaining that intensity% and weight% measurements can each provide useful information regarding a sample of nanoparticles’ size characteristics).) While some flexibility in selection of PCS methodologies is indicated, nothing in any of this language states or implies that a *non*-PCS methodology is indicated.

Accordingly, I will accept Samsung’s interpretation that nanoparticles’ average size and standard deviation must be measured by a valid PCS methodology.

3. “surface”

Term	RPI’s Construction	Samsung’s Construction
“surface nanoparticle[] . . . surface/surface of the nanoparticle[]” (’339 Patent, all asserted claims; ’119 patent all asserted claims.)	layer at the interface of a nanoparticle and any surrounding medium	outermost, exterior boundary of the nanoparticle

All claims of the asserted patents refer to the “surface” of a nanoparticle, particularly as the site of elemental passivation. RPI argues that the parties’ dispute over the meaning of “surface” is rooted in their disagreement over whether the term nanoparticle itself encompasses nanoscale particles with or without shells. (RPI Opening Br. at 18.) Nonetheless, RPI urges that its interpretation of a nanoparticle’s “surface” as a “layer” emphasizes that a nanoparticle’s surface includes part of the nanoparticle itself and is thus more technically accurate than describing the surface as a “boundary.” (*Id.* at 19-20.) Samsung counters that the ordinary understanding of an object’s surface is its “outermost, exterior boundary,” a definition consistent with the alleged invention being nanoparticles with elementally passivated surfaces which necessarily lack shells. (Samsung Opening Br. at 15-16.) Indeed, according to Samsung, RPI’s interpretation suggests that a relevant nanoparticle surface may lie between a nanoparticle’s core and its semiconductor shell—i.e., it may be “buried” within the “core-shell nanoparticle structure”—even though the asserted patents do not describe any nanoparticle with an elementally passivated surface that is also surrounded by a shell. (*Id.* at 16-17.)

I agree that the parties’ dispute over the definition of nanoparticle overlaps with their dispute over the meaning of “surface”; my resolution of the nanoparticle dispute in Samsung’s favor, *see supra*, leads easily, if not inevitably, to a similar resolution of the “surface” dispute. An object’s “surface” most naturally refers to its exterior or outermost boundary, not to some

interfacial layer between the object and its surroundings. (See '319 patent 2:40-67, 3:30-67; *see also, e.g.*, Reisberg Decl. Ex. N (defining “surface” as “the exterior or upper boundary of an object or body”); Reisberg Decl. Ex. O (defining “surface” as “the outside of an object or body”).) Indeed, given my conclusion that the term “nanoparticle” standing alone refers to a nanoscale particle without shells, the relevant “surface” at issue is the semiconductor nanoparticle’s exterior, adjacent to the medium or environment surrounding it. (See '319 patent 3:30-67 (“A passivated surface comprises [a] surface having passivated dangling bonds where a passivating element is bound to the dangling bonds . . . a true or ‘elemental’ passivated surface should be distinguished from formation of a semiconductor or organic surfactant shell around a nanoparticle of the prior art”).) For the elementally passivated nanoparticles central to the asserted patents, it is inherent to this invention that their surfaces be in direct contact with the surrounding medium and exposed to surrounding nanoparticles; their surfaces cannot be defined to be “buried” within their own shells. (See '319 patent 3:30-67; Green Decl. ¶¶ 41-43.) Thus, RPI’s attempts to define “nanoparticle” and “surface” in order to accommodate the use of shelled nanoparticles in elemental passivation find no support in the language of the asserted patents. I adopt Samsung’s construction of “surface.”

B. Elemental Passivation Terms

1. “passivate”

Term	RPI’s Construction	Samsung’s Construction
1. “passivate” 2. “[passivate the/ passivated] surface” (All asserted claims.)	1. reduce the number of undesirable surface states in the bandgap of a nanoparticle 2. a surface having passivated dangling bonds to reduce the number of undesirable surface states in the bandgap of a nanoparticle	modify the surface of a nanoparticle to reduce agglomeration

The asserted patents use the terms “passivate” and “passivated surface” to refer to characteristics of the patented methodology and nanoparticles. My prior interpretations of the patents’ terms already suggest the proper construction here, but I will briefly discuss and resolve the parties’ disagreement on this point.

RPI argues that its interpretation would define the term “passivate” according to its “ordinary and customary meaning” and in line with the primary issues that passivation is meant to address: namely, dangling bonds and other defects on a nanoparticle’s surface that can cause agglomeration or diminished optical and electronic performance.³ (RPI Opening Br. at 20-21, 23.) Indeed, RPI urges that Samsung’s interpretation is improperly limited and contrary to the more general, ordinary meaning of “passivate.” (*Id.* at 22.) Samsung counters that “passivity” in this context refers to conditions of a surface that “retard[] a specified chemical reaction at that surface,” which in

³ The parties agree that the term “dangling bond” refers to an “unsatisfied bond on the surface of the nanoparticle.” (Samsung Brief at 18 n.16.)

this case is any reaction between nanoparticles' dangling bonds that causes agglomeration of those particles. (Samsung Opening Br. at 18.) Samsung maintains that the asserted patents "equate" passivation of nanoparticles with reducing agglomeration among those particles. (*Id.* at 19-21.) Samsung adds that RPI's own prior statements in this case emphasized that the "allegedly novel passivated particles do not agglomerate or exhibit reduced agglomeration over the prior art." (*Id.* at 21.)

Looking to the language of the asserted patents in context with their purpose, I again agree that Samsung's interpretation is the better of the two. The patents' inventor noted that (1) prior-art nanoparticles suffer from issues with agglomeration and non-uniform size distribution because dangling bonds cause separate nanoparticles to bond together, and (2) forming nanoparticles with a passivated surface diminishes bonding between nanoparticles and thus reduces agglomeration. ('339 patent, 3:25-57; '119 patent, 3:30-61). Indeed, the sole purpose of elemental passivation, as outlined in the asserted patents, would appear to be the suppression of agglomeration, which has associated benefits. (*See, e.g.*, '339 patent at Abstract ("[S]emiconductor nanoparticles having an elementally passivated surface . . . are capable of being suspended in water without substantial agglomeration"); 18:64-19:20 ("[T]he method of the preferred embodiments of the present invention . . . avoids or reduces the agglomeration of nanoparticles into clusters"). As the asserted patents note, these "passivated nanoparticles . . . do not significantly agglomerate"), (*id.* at 3:60-63) and "are significantly more stable" (*id.* at 5:23-30), compared to prior-art nanoparticles. Finally, the patent's goal of achieving "elementally passivated" nanoparticles is intrinsically expressed solely in relation to data regarding reduced agglomeration from PCS measurements of average size and size distribution. (*Id.* 18:65-19:20.)

Accordingly, I find that "passivate" and its related usages in this context refer to modifying the surface of a nanoparticle to reduce agglomeration, as Samsung suggests, and I adopt Samsung's construction.

2. “elementally passivate”

Term	RPI’s Construction	Samsung’s Construction
<p>1. “elementally passivate</p> <p>2. “elementally passivated”</p> <p>3. “elementally passivated surface”</p> <p>4. “passivating element”</p> <p>(All asserted claims.)</p>	<p>1. binding a passivating element to dangling bonds to reduce the number of undesirable surface states in the bandgap of a nanoparticle</p> <p>2. having passivating elements bound to the dangling bonds to reduce the number of undesirable surface states in the bandgap of a nanoparticle</p> <p>3. a surface having passivated dangling bonds, where a passivating element is bound to the dangling bonds to reduce the number of undesirable surface states in the bandgap of a nanoparticle</p> <p>4. an element that binds to and passivates dangling bonds to reduce the number of undesirable surface states in the bandgap of a nanoparticle</p>	<p>passivate the nanoparticle surface using an element, where the nanoparticle is not surrounded by a shell</p>

Given that the asserted patents primarily concern “elemental passivation,” the term’s definition is critical and must cohere with the constructions of other fundamental patent terms. Indeed, the parties essentially agree that their dispute over the phrase “elementally passivated” and related terms is rooted in their disagreements over the meaning of the terms “passivate” and “nanoparticle” (RPI Opening Br. at 25-26), already resolved in Samsung’s favor. Along those lines, RPI argues that Samsung’s interpretation improperly excludes shelled nanoparticles and contains no reference to a passivating element binding to a dangling bonds. (*Id.* at 26.) Samsung argues to the contrary that its interpretation is justified because the patent language makes clear that “elementally passivated nanoparticles cannot have shells.” (Samsung Opening Br. at 21-22.)

Based on my findings, *supra*, interpreting “nanoparticle,” “surface,” and “passivate,” I conclude that Samsung’s interpretation of “elemental passivation” is more persuasive and faithful to the straightforward language of the patent. As already discussed, the asserted patents fundamentally concern a process of modifying the surface of unshelled nanoparticles to reduce their tendency to agglomerate. Just as that focus helped orient the definitions of “nanoparticle,” “surface,” and “passivate,” it also animates the patent language describing “elemental passivation” itself. As the asserted patents explicitly state, “nanoparticles that are encapsulated in a shell are not truly ‘passivated’” and “nanoparticles coated in a shell are not elementally passivated” (’339 patent 3:52-63; ’119 patent 3:56-67.) Thus, nothing in the asserted patents’ language or purpose suggests that a definition of “elemental passivation” should accommodate the use of shelled nanoparticles by referring to reduced “undesirable surface states in the bandgap of a nanoparticle” (RPI’s interpretation) rather than the more direct construction of “passivating the nanoparticle surface” (Samsung’s interpretation) Based on my prior findings and the patent language itself, I adopt Samsung’s interpretation of “elementally passivate.”

C. Synthesis Terms

1. “aqueous solution”

Term	RPI’s Construction	Samsung’s Construction
“aqueous solution” (’339 Patent, cl. 13; ’119 Patent, cl. 1, 2, 21, 22, 26.)	a solution in which water is a solvent	solution where water is the main solvent

The patents describe the formation of elementally passivated nanoparticles as occurring in two steps, the first of which involves the nanoparticles being formed in an “aqueous solution.” (’339 patent 20:32-34; ’119 patent 19:61-22:10.) RPI argues that its interpretation “accommodates solutions in which multiple solvents and solutes are present,” as long as *one* of such solvents or solutes is water. (RPI Opening Br. at 26-27.) Indeed, they urge that Samsung’s interpretation is overly limited and injects ambiguity into the definition of an “aqueous solution” by leaving unspecified at what point water would become the “main” solvent in a given solution. (*Id.* at 27.) Samsung counters that the ordinary meaning of the term implies that water must be “the main solvent comprising the solution” and that the patent’s focus on “water-based chemistry to form the disclosed nanoparticles” reinforces Samsung’s narrower construction. (Samsung Opening Br. at 22-24.)

Here, RPI’s interpretation is the better one. Samsung’s interpretation only defers the question of what constitutes a “main” solvent in a potentially multi-solvent solution. (See Palomaki Dec. at ¶¶ 60-61 (noting that an “aqueous solution” may refer to a solution in which water is acting as one of multiple solvents.) Samsung does not specify any measure or threshold for a solvent to be considered the “main” one, such as the amount of the solvent in the mixture, the role of the solute being dissolved by the solvent, or some other factor. While the focus of the asserted patents may well be water-based chemistry, that focus is adequately accounted for by RPI’s definition and does not warrant the added ambiguity of defining what constitutes the “main

solvent” in a solution containing water. See *E-Pass Techs.*, 473 F.3d 1213, 1220 (Fed. Cir. 2007). Accordingly, I adopt RPI’s construction and agree with RPI that an “aqueous solution” is a solution in which water is a solvent.

2. “[to form the / forming] semiconductor nanoparticles”

Term	RPI’s Construction	Samsung’s Construction
“[to form the/ forming] semiconductor nanoparticles” (’339 Patent, cl. 12, 13; ’119 Patent, cl. 1, 2, 10, 11, 20.)	[to fabricate the / fabricating] semiconductor nanoparticles	[to grow the / growing] semiconductor nanoparticles

As noted above, the process of synthesizing elementally passivated nanoparticles takes place in two steps: the first in which nanoparticles are “formed” in an aqueous solution, the second in which the nanoparticles are “etched” to a desired size. The parties now disagree about how to interpret “form” or “forming” in the first step. RPI would substitute the verb “fabricate” to define the process of forming nanoparticles, arguing that its interpretation directly captures the patent language. RPI criticizes Samsung’s alternative proposal to substitute the term “grow,” arguing that it is artificially limited to processes increasing nanoparticle size and based only on passing references in the asserted patents to prior art. (RPI Opening Br, at 30-32.) Samsung maintains that its interpretation properly highlights the first step of “making” semiconductor nanoparticles. (Samsung Opening Br. at 25-26.) To “form” a nanoparticle, says Samsung, refers only to this first, “constructive” step while RPI’s interpretation would conflate the first with the second, “destructive” step. (*Id.* at 26-27.)

Thus both parties suggest a swap for the actual patent language. Here, I find RPI’s swap the more persuasive, and find Samsung’s to be more idiosyncratic and less anchored in the patent language. Though both “fabricate” and “grow” might be used in describing the process of “forming”

nanoparticles, the term “fabricate” appears more regularly in the language of the patent itself. (See, e.g. ‘339 and ‘119 patents (both entitled “Passivated Nanoparticles, Method of Fabrication Thereof, and Devices Incorporating Nanoparticles.”); ‘339 patent 5:19-23 (“The passivated nanoparticles may be fabricated using an environmentally friendly, non-toxic, low temperature . . . process.”).) The term “grow” is, in comparison, is used only in reference to prior art methods of forming semiconductor nanoparticles. (See e.g., ‘339 patent 4:4-10.) While I am unconvinced that the term “grow” inappropriately highlights processes increasing nanoparticle size in this context, I am similarly unpersuaded that the term is necessary to underscore the first, constructive step of elemental passivation.

On balance, RPI’s interpretation hews more closely to the patent language and so I will adopt it.

3. “reactant”

Term	RPI’s Construction	Samsung’s Construction
“reactant” (‘119 Patent, cl. 10, 11, 20.)	a substance or chemical species undergoing chemical reaction	substance other than an acid that enters into and is altered in the course of a chemical reaction

The parties agree that a “reactant” is a substance undergoing or changed by a chemical reaction, but disagree as to whether an acid may be such a substance. (RPI Opening Br. at 28-29; Samsung Opening Br. at 27.)

RPI argues that its interpretation of “reactant” reflects the term’s ordinary meaning and its usage in the patents “to encompass a broad range of potential materials,” noting that the patents include a non-exhaustive list such possible reactants. (RPI Opening Br. at 28-29.) Indeed, RPI maintains that acids are well-known reactants and that both acids and bases would be “potential candidates for use as reactants in the Asserted Patents” unless explicitly stated otherwise. (*Id.* at 29-30.) Samsung counters that the patent language directs acids to be excluded from the definition of reactants where, as

here, “reactant” is used in reference to the “constructive step of forming the semiconductor nanoparticle” while “acid” is used only in reference to the second step of “etching” nanoparticles to reduce their size. (Samsung Opening Br. at 27-28.) Indeed, Samsung argues that the asserted patents refer to acids only in the context of etching liquids, never as reactants, and even differentiate reactants from acids in describing the process of nanoparticle formation. (*Id.* at 28-29.)

I agree with RPI that its less limited construction is the more appropriate one. “Reactant,” in common usage, is not a narrow term, and would appear to encompass a participant in a chemical reaction. The asserted patents use the term “reactant” broadly and contain a non-exhaustive list of potential materials, including hydrosulfuric acid. (See ‘339 patent 7:33-46, ‘119 patent 7:26-43.) This use alone would indicate that a less limited view of “reactants” is necessary for consistency. The asserted patents evidence no clear intent to impose a categorical limitation barring all acids from the definition of reactant. See *Grober v. Mako Products, Inc.*, 686 F.3d 1335, 1341, (Fed. Cir. 2012); *Ecolab, Inc. v. FMC Corp.*, 569 F.3d 1335, 1342 (Fed. Cir. 2009). It may be true that the primary use of acids in elemental passivation is as “etching liquids” to reduce nanoparticle size. Still, that usage does not warrant artificially restricting the meaning of “reactant” or “acid” to mutually exclusive spheres absent any more explicit indication otherwise. (See, *e.g.*, ‘339 patent 6:13-46.) I therefore adopt RPI’s interpretation of “reactant.”

4. “undoped”

Term	RPI’s Construction	Samsung’s Construction
“undoped” (’339 Patent, cl. 24.)	free of any material different in composition from the semiconductor nanoparticle that is purposefully introduced in small amounts into the crystal of the nanoparticle as opposed to on its surface to modify its electronic properties	free of any material different in composition from the semiconductor nanoparticle that is purposefully introduced into the crystal of the nanoparticle as opposed to on its surface

The asserted patents state that in determining nanoparticle size using PCS, the measured nanoparticles must be “undoped semiconductor nanoparticles.” (’339 patent 21:1-6, 12-14.) The parties essentially agree that an “undoped” nanoparticle is “free of any material different in composition from the semiconductor nanoparticle [i.e., an impurity] that is purposefully introduced into the crystal of the nanoparticle as opposed to on its surface.”

RPI argues for two additional limitations—that the impurity excluded from the semiconductor nanoparticle was introduced (1) “in small amounts” and (2) “to modify [the nanoparticle’s] electronic properties.” (RPI Opening Br. at 32-35.) RPI urges that these limitations are warranted because the patent language makes “clear that the purpose of doping a nanoparticle is to modify its electronic properties.” (*Id.* at 32-33.) Moreover, RPI maintains that Samsung’s interpretation is too broad because without specifying that the impurity is introduced in small amounts, “it cannot differentiate between a nanoparticle that is ‘undoped’ and a nanoparticle that is ‘unalloyed.’” (*Id.* at 34-25.)

Samsung counters that RPI’s suggested limitations are unwarranted, for two reasons. First, the phrase “in small amounts” is “unduly vague and subjective,” offering “no clarification regarding the threshold at which a material ceases to be a dopant due to its concentration within the

semiconductor nanoparticle.” (Samsung Opening Br. at 29-30.) Second, the phrase “to modify [the nanoparticle’s] electronic properties” is unduly narrow, improperly excluding dopants that can modify a nanoparticle’s magnetic properties, as the ‘339 patent references. (*Id.* at 30.)

I agree with Samsung’s interpretation because the limitations suggested by RPI add ambiguity and lack sufficient basis in the patents’ text. First, RPI offers no measure of how to judge the phrase “in small amounts” and without such a guidepost, any measure would be rendered subjective and imprecise. *See Depomed, Inc. v. Sun Pharma Glob. FZE*, No. 11-3553, 2012 WL 3201962, at *5 (D.N.J. Aug. 3, 2012) (rejecting constructions that “only serve[] to add vagueness to the term, such that [the] proposed construction would itself require additional defining”) (citing *E-Pass Techs*, 473 F.3d at 1220). Second, limiting the term “undoped” to a modification of the nanoparticles’ “electronic properties” alone is unduly narrow, because the asserted patents also describe doping agents that alter a nanoparticle’s magnetic properties. (‘339 patent 13:47-58 (“The magnetic nanoparticles may be doped into the semiconductor nanoparticles using any known doping techniques”); ‘119 patent 13:49-67 (“In a second preferred aspect of the fifteenth embodiment, the magnetic storage medium comprises a substrate containing the semiconductor nanoparticles doped with atoms of the magnetic material.”).) Without more, RPI has offered too little a justification for its more limited construction.

I adopt Samsung’s construction of “undoped.”

IV. ORDER

I construe the disputed terms as follows:

1. “Nanoparticle” means a nanoscale particle that does not have any shells.
2. “Nanoparticles [having/have] an average size between [X] with a size standard deviation of [Y] of the average nanoparticle size determined by photon correlated spectroscopy (PCS)” means nanoparticles [having/have] an average hydrodynamic diameter between [X] with a standard deviation of [Y] as measured by PCS.

3. “Surface” of a nanoparticle means the outermost, exterior boundary of the nanoparticle.
4. “Passivate” a nanoparticle’s surface means to modify the surface of the nanoparticle to reduce agglomeration.
5. “Elementally passivate” a nanoparticle’s surface means to passivate the nanoparticle surface using an element, where the nanoparticle is not surrounded by a shell.
6. “Aqueous solution” means a solution in which water is a solvent.
7. “[to form the/forming] semiconductor nanoparticles” means [to fabricate the/fabricating] semiconductor nanoparticles.
8. “Reactant” means a substance or chemical species undergoing chemical reaction.
9. “Undoped” means free of any material different in composition from the semiconductor nanoparticle that is purposefully introduced into the crystal of the nanoparticle as opposed to on its surface.

A separate order will issue.

Dated: September 6, 2022

/s/ Kevin McNulty

Hon. Kevin McNulty
United States District Judge