United States District Court,
N.D. Georgia, Atlanta Division.

**FURUKAWA ELECTRIC NORTH AMERICA, INC,**
Plaintiff.
v.
**STERLITE OPTICAL TECHNOLOGIES, LIMITED; Sterlite Optical Technologies, Inc.; Anand Agarwal; and Brian Chomniak,**
Defendants.

Civil Action No. 1:02-CV-2149-CAP

**Jan. 18, 2006.**

***REPORT OF SPECIAL MASTER ON MARKMAN CLAIM INTERPRETATION PROCEEDINGS***

**JAMES L. EWING, IV, Special Master.**

***TABLE OF CONTENTS***

***LIST OF AUTHORITIES***

**CASES**

**STATUTES**



The Special Master, appointed by Order dated October 18, 2005, reports as follows with recommended interpretation for patent claim terms at issue in this action.

**I. Background**

**A. Patents in Suit**

Plaintiff, Furukawa Electric North America, Inc. ("Furukawa") asserts (among other things) that Sterlite Optical Technologies, Inc. and Sterlite Optical Technologies, Ltd. (collectively "Sterlite Parties") infringe three patents which relate to optical fibers and processes for making them: (1) U.S. Patent No. 4,909,816 issued March 20, 1990 to MacChesney, et al. entitled "Optical Fiber Fabrication and Resulting Product" ("MacChesney 816 Patent); (2) U .S. Patent No. 5,298,047 issued March 29, 1994 to Hart, Jr., et al., entitled "Method of Making a Fiber Having Low Polarization Mode Dispersion Due to a Permanent Spin" ("Hart 047 Patent") and (3) U .S. Patent No. 5,418,881 issued May 23, 1995 to Hart, Jr., et al., entitled "Article Comprising Optical Fiber Having Low Polarization Mode Dispersion, Due to Permanent Spin" ("Hart 881 Patent").

**B. The Claim Interpretation Proceeding**

Furukawa filed its "Plaintiff's *Markman* Brief on Proper Claim Construction" ("Furukawa Opening Brief") on August 12, 2005. On the same day, the Sterlite Parties filed their "Defendants' Opening Brief on Claim Construction for U.S. Patent No. 4,909,816" ("Sterlite Opening Brief on MacChesney 816 Patent") and "Defendants' Opening Brief on Claim Construction for U.S. Patent No. 5,298,047 and 5,418,881" ("Sterlite Opening Brief on Hart Patents"). On September 1, 2005, Furukawa filed its "Plaintiff's Brief in Response to

Defendants' *Markman* Briefs" ("Furukawa Response Brief") and the Sterlite Parties filed their "Defendants' Responsive Brief on Claim Construction for U.S. Patent No. 4,909,816; 5,298,047 and 5,418,881" ("Sterlite Response Brief"). This matter was heard on December 8, 2005 at the offices of Kilpatrick Stockton, LLP in Atlanta, Georgia. A transcript of those proceedings, with confidential portions designated by counsel redacted, constitutes Exhibit 1 and is filed herewith. Also filed with the Court are a paper copy of the entire transcript (filed under seal) and the Exhibits listed in the transcript (Exhibits 14-19 of which are designated confidential and filed under seal). This Report does not rely on any such confidential portions of that transcript or any of the Exhibits listed in that transcript which were designated confidential (Exhibits 14-19).

**C. MacChesney** 816 Patent

Glass optical fibers transmit light efficiently and sometimes over long distances at least in part by exploiting "refractive index" properties of the glass to minimize light leakage or loss. The refractive index of a material is the ratio of the speed of light in a vacuum to the speed of light in the material. Furukawa Opening Brief, p. 2. The higher refractive index of water as compared to that of air, for example, accounts for the "bending" of light rays which causes fish to appear at a depth shallower than where they are actually swimming, or the water surface to look like a mirror to an underwater diver, respectively. Glass lenses similarly exploit the difference in refractive index between glass and air.

Analogously, certain optical fibers feature an inner glass "core" which can have a higher or different refractive index than a concentric outer glass "cladding." This arrangement causes light rays which would otherwise scatter when propagating in the fiber to remain in the core, and thus "channels" the light in the core and reduces light leakage or loss in the fiber. *See* Id. at 2. The MacChesney 816 Patent discloses and claims processes for making optical fiber "preforms," which are glass rods or tubes from which such optical fiber can be "drawn." Sterlite Opening Brief on MacChesney Patent, p.1; Furukawa Opening Brief pp. 1-3.

Preforms made according to the MacChesney 816 Patent include a core and cladding (and perhaps other layers which feature different refractive indices) which correspond to the core and cladding of the fiber drawn from such preforms. A preform can be several feet in length and several inches in diameter. By contrast, the diameter of the optical fiber drawn from the preform is far smaller (typically in the range of 100 m or approximately 1/2500 inch) so that several hundred kilometers of optical fiber can sometimes be drawn from a single preform. The drawing process can include positioning the preform essentially vertically, heating the lower end to form a glass drip, and pulling or drawing that drip from the heated end of the preform to form the optical fiber which is then cooled, coated, and wound onto a reel. Furukawa Opening Brief, pp. 2, 3.

According to the MacChesney 816 Patent, gas-phase precursor reactants together with oxygen are introduced into a glass tube in the form of a constantly moving stream. Tube and reactants are heated to reaction temperature using a moving hot zone produced by a moving heating means that traverses the outside surface of the tube. Homogenously produced glass material associated with the reaction ("soot") collects on the inner tube walls and is fused into a continuous layer associated with the moving hot zone. This process can produce glass portions with different refractive indices by varying the reactant composition to include, for instance, dopants which change the glass refractivity index. MacChesney 816 Patent, Col. 2, line 53-Col. 3, line 24. The tube can be collapsed to form a solid preform by, among other things, changing the way it is heated. Collapsing the tube is not necessary, according to the MacChesney Patent disclosure, however, since fiber can be drawn from tubular preforms or solid preforms. MacChesney 816 Patent, Col. 7,

ll. 32-43.

Processes disclosed in the MacChesney 816 patent are sometimes referred to as Modified Chemical Vapor Deposition or MCVD processes. Among other things, such processes are characterized by the MacChesney 816 Patent as an improvement over conventional Chemical Vapor Deposition ("CVD") processes which are slower, and over conventional "soot" processes which produce impurities in the glass. Furukawa Opening Brief, pp. 3-4; MacChesney 816 Patent, Col. 2, line 8-Col. 3, line 33.

**D. Hart Patents**

Aside from scattering, another problem that can cause inefficiency when modulated light is traveling or propagating in an optical fiber is loss due to "birefringence." Certain optical fibers known as "single mode" fibers transmit light that is polarized in two distinct polarization modes. Anomalies such as non-circularity of the fiber, stresses within the fiber, and physical forces on the fiber can cause refractive indices of the glass forming the fiber to vary in an undesirable way for each of the two modes, thus distorting propagation of the light. Furukawa Opening Brief, p. 5; Exhibit 4, J. Hecht, *Understanding Fiber Optics* 117 (4th ed.2002); Hart 047 Patent, Col. 1, ll. 15-27. Such birefringence can, for instance, cause spreading or blurring of the light pulses transmitted in the optical fiber, a phenomenon known as polarization mode dispersion or PMD. Furukawa Opening Brief, Exhibit 4; J. Hecht, *Understanding Fiber Optics* 118 (4th Ed.2002); Hart 047 Patent, Col. 1, ll. 43-48. PMD is undesirable, especially for optical fiber utilized for intensive data transmissions such as in cable television systems. Id. The Hart Patents reflect the discovery that PMD can be substantially reduced if a torque or twisting force is applied to the fiber while it is being drawn so that a "spin" is frozen into or "impressed on" the fiber according to certain techniques. The Hart 047 Patent contains claims for methods of making such optical fibers, and the Hart 881 Patent contains claims for certain fibers formed according to such techniques. The Hart 881 Patent is a continuation of a divisional of the application which resulted in the Hart 047 Patent, and thus contains the same specification text and drawings, even though the text appears at slightly different column and line numbers in each patent.

**II. Legal Standards for Claim Interpretation**

A patent is a fully-integrated written instrument, and claim construction is a matter of law for the Court. *See* Markman v. Westview Instruments, Inc., 52 F.3d 967, 978 (Fed.Cir.1995), aff ' d, 517 U.S. 370 (1996).

In order to interpret patent claims properly, reference must first be made to the claim language. Abtox Inc. v. Exitron Corp., 122 F.3d 1019, 1023 (Fed.Cir.1997); Mantech Envtl. Corp. v. Hudson Envtl. Servs., Inc., 152 F.3d 1368, 1371 (Fed.Cir.1998); Thermalloy, Inc. v. Aavid Eng'g, Inc., 121 F.3d 691, 692 (Fed.Cir.1997). In this context the words of the claim are generally to be given their plain, ordinary meaning unless a different meaning is ascribed to them in the patent document. Kraft Foods v. Int'l Trading Co., 203 F.3d 1362, 1366 (Fed.Cir.2000). "General descriptive terms will ordinarily be given their full meaning; modifiers will not be added to broad terms standing alone." Johnson Worldwide Assocs. Inc. v. Zebco Corp., 175 F.3d 985, 989 (Fed.Cir.1999); Va. Panel Corp. v. MAC Panel Co., 133 F.3d 860, 865-66 (Fed.Cir.1997); Bell Communs. Res., Inc. v. Vitalink Communs. Corp., 55 F.3d 615, 621-22 (Fed.Cir.1995).

The context in which a patent claim term is used must be considered in determining the ordinary and customary meaning of the term. Phillips v. AWH Corp., 415 F.3d 1303, 1314 (Fed.Cir.2005); Vitronics Corp. v. Conceptronic Inc., 90 F.3d 1576, 1582 (Fed.Cir.1996). The context in which a term is used in a claim can be highly instructive. Phillips, 415 F.3d at 1314; *see, e .g.,* Mars, Inc. v. H.J. Heinz Co., 377 F.3d 1369, 1374 (Fed.Cir.2004). Other claims in the patent can also constitute instructive context for

interpretation of claim language. *See* Phillips, 415 F.3d at 1314; Vitronics, 90 F.3d at 1582.

Claims must be read in view of the patent specification. Phillips, 415 F.3d at 1315; Vitronics, 90 F.3d at 1582. Additionally, and consistent with the ordinary meaning of claim language, it is important to consider other evidence that is intrinsic to the patent. Phillips, 415 F.3d at 1317; Vitronics, 90 F.3d at 1582. Intrinsic evidence includes the claims themselves, the specification and the prosecution history. *Id*. Extrinsic evidence such as inventor testimony and dictionary definitions is to be given only limited weight in interpretation of patent claim terms. Phillips, 415 F.3d at 1317-19.

The Federal Circuit has ruled that it is error to rely upon evidence extrinsic to the patent record in order to alter the meaning of the claims that is ascertained from the intrinsic record. Markman v. Westview Instruments, Inc., 52 F.3d 967, 981 (Fed.Cir.1995), *aff'd,* 517 U.S. 370 (1996); Vitronics Corp., 90 F.3d at 1584. "Extrinsic" evidence is "all evidence external to the patent and prosecution history," which includes prior art not cited during prosecution, dictionaries, inventor or artisan testimony, and "expert" or "patent lawyer" testimony about the meaning of the claims. Markman, 52 F.3d at 980. Regarding reliance on litigation-induced inventor testimony, the Federal Circuit has cautioned:

... the testimony of Markman [the inventor] and his patent attorney on the proper construction of the claims is entitled to no deference.

Markman, 52 F.3d at 983; *see also* Bell & Howell Document Mgmt. Prods. Co. v. Altek Sys., 132 F.3d 701, 706 (Fed.Cir.1997).

Where intrinsic evidence is dispositive, extrinsic evidence such as expert testimony, inventor testimony, and prior art not of record in the patent prosecution history should not influence the Court's claim interpretation. Vitronics, 90 F.3d at 1584. Courts may, however, rely on dictionary definitions when construing claim terms, so long as the dictionary definition does not contradict any definition found in or ascertained by a reading of the patent documents, even though dictionaries are extrinsic evidence. Id. at 1584 n.6.; Phillips, 415 F.3d at 1318.

Although the words of the claims are to be read in light of the specification of the patent, the specification cannot be used improperly as a source from which to read limitations into the claims. Johnson Worldwide, 175 F.3d at 989-90 ("[C]laim terms cannot be narrowed by reference to the written description or prosecution history *unless* the language of the claims invites reference to those sources.") (emphasis added); McCarty v. Lehigh Valley R.R., 160 U.S. 110, 116 (1895) ("[I]f we once begin to include elements not mentioned in the claim in order to limit such claim ..., we should never know where to stop."). "In other words, there must be a textual reference in the actual language of the claim with which to associate a proffered claim construction." Johnson Worldwide, 175 F.3d at 990. Similarly, the prosecution history cannot be used improperly as a source for adding limitations not associated with a textual reference in the words of the claim. *Id*.

**III. MacChesney** 816 Patent **Issues**

The MacChesney 816 Patent is one of a family of related patents. It issued from a line of patent applications beginning with application Serial No. 444,705 filed on February 22, 1974. Several related applications in that line resulted in other patents, including U.S. Patent Nos. 4,217,027; 4,334,903; and 4,504,299. Neither Furukawa nor the Sterlite parties have introduced the entire prosecution history of the MacChesney 816

Patent or the Hart Patents into the record, or all of the references cited in those prosecution histories, though certain documents from those prosecution histories and certain of those references have been made of record by one or both of the parties in the course of briefing this *Markman* proceeding.

The application from which the MacChesney 816 Patent issued was filed on July 26, 1983. Claims were copied from U.S. Patent No. 4,341,441 to Lighty, a third party patent which has not been made of record in these proceedings or considered, to provoke an interference with that patent and thus determine which party had priority and ownership of the subject matter of the claims. Furukawa Opening Brief, pp.10, 11. The interference proceeding concluded favorably to the MacChesney 816 Patent owners on July 1, 1987. The application continued through the examination process, and the MacChesney 816 Patent issued on May 20, 1990.

**A. MacChesney** 816 Patent **Claim Terms**

The parties disagree about the proper interpretation of language found in all claims of the MacChesney 816 Patent. The contested claim terms are first used in claims 1, 4, and 7 which are reproduced below with contested words and phrases italicized and bolded. Claims 9, 12, and 15 correspond respectively to Claims 1, 4, and 7 and use the same contested claim terms. All other claims of the MacChesney 816 Patent, claims 2, 3, 5, 6, 8, 10, 11, 13, 14, 16 and 17, depend from one of these independent claims directly or indirectly, and thus incorporate the claim terms of the claim or claims from which they depend. Claims 1, 4, and 7 are stated as follows:

1. A method of making an optical fiber ***preform*** suitable for drawing into an optical fiber including the steps of: providing a hollow glass tube of a first refractive index and ***having a predetermined length*** with a bore formed therethrough; introducing into said bore, ***in unreacted dry vapor form,*** material that forms a glass layer, coating said bore by ***thermally depositing said material*** thereon to form a glass layer of higher refractive index than the refractive index of said tube; rotating said glass tube about its longitudinal axis by a rotating device, while heating said coated tube to collapse said tube into a ***solid preform having substantially the same length as said predetermined length*** whereby the glass coating layer becomes a core of said higher index of refraction than the refractive index of said tube.

4. A process for fabrication of a glass optical fiber ***preform*** having a core section and a cladding comprising the steps of: introducing a moving stream of a ***vapor mixture including at least one compound glass forming precursor together with an oxidizing medium*** into a tube of a ***predetermined length,*** heating the tube and contents by a moving hot zone produced by a correspondingly moving heat source external to the tube so as to react the said mixture and produce a glassy layer on the inner surface of the tube, rotating said glass tube about its longitudinal axis by a rotating device, while heating said coated tube to collapse said tube into a ***solid preform having substantially the same length as said predetermined length*** whereby the glass coating layer becomes a core having a higher index of refraction than the refractive index of said tube.

7. A method of making an optical fiber ***preform*** having a glass core and a glass cladding comprising the steps of: introducing a stream of vapors into the interior of a glass tube having a first refractive index and a ***predetermined length,*** said vapor being ***chemically reactive in the process of heating to form glass substantially similar to that of said glass core,*** establishing a ***localized hot zone*** in the interior of said glass tube to react vapor within said hot zone, moving said hot zone longitudinally along substantially the same length of said glass tube to coat a layer of glass substantially similar to said glass core on the inside wall of said glass tube, rotating said glass tube about its longitudinal axis by a rotating device, while heating said

coated tube to collapse said tube into a solid preform having ***substantially the same length as said predetermined length*** whereby the glass coating layer becomes a core having a higher index of refraction than the refractive index of said tube.

MacChesney 816 Patent, Col. 10, ll. 31-45, 53-68; Col. 11, ll. 8-25 (emphasis supplied).

**B. MacChesney** 816 Patent **Recommended Claim Term Interpretation**

**1. "Preform"**

Furukawa proposes that the term "preform" as used in all claims of the MacChesney 816 Patent should be interpreted as follows:

A glass structure, including a tube or rod made from the claimed process, not necessarily including the hollow glass tube, from which an optical fiber may be drawn.

Furukawa also proposes that the term "solid" which modifies the last use of the word "preform" in all claims should be interpreted to mean the following:

The preform is not hollow and has been substantially collapsed. Furukawa Opening Brief, p. 25

The Sterlite Parties propose that the term "preform" should be interpreted to mean the following:

A glass rod or tube that can be loaded into a draw tower and drawn into optical fiber.

Sterlite Opening Brief on MacChesney Patent, p. 3.

The Sterlite Parties do not propose an alternative meaning for the term "solid" in connection with the MacChesney 816 Patent.

The parties agree that a "preform" is a glass rod or tube from which optical fiber may be drawn. Furukawa Response Brief, p. 8; Sterlite Response Brief, p. 6. The parties disagree on whether the term requires that the preform made according to the claimed process necessarily includes the "hollow glass tube" referred to at the beginning of claim 1 (MacChesney Patent Col. 10, line 32) that is used to begin the claimed process, and whether the term requires that this tube be loaded into a "draw tower."

The Sterlite Parties point to, among other sources, MacChesney 816 Patent, Col. 3, ll. 34-42 for the proposition that the glass tube becomes the clad or outer layer of the preform and is therefore part of the preform made according to the claimed process. Sterlite Opening Brief on MacChesney Patent, pp. 4, 5. This language at Column 3 does state that, "in usual processing, the tube which served as the deposition substrate becomes the clad." MacChesney 816 Patent, Col. 3, ll. 40-42. However, the quoted paragraph continues as follows:

Variations may include removal of the tube, as well as deposition of additional material on the outer surface. The tube serving as the substrate during deposition may be retained to serve as a clad, may be removed, or may, during simultaneous deposition, on its outer surface be provided with encompassing layer/s.

MacChesney 816 Patent, Col. 3, ll. 45-50.

It is true, although not briefed by either party, that the claims of the MacChesney 816 Patent all require that the glass coating layer becomes a core of higher index of refraction than the refractive index of the tube. MacChesney 816 Patent, Col. 10, ll. 43-45; 66-70; Col. 11, ll. 23-25; 45-48; Col. 12, ll. 18-20; 44-47. However, that language does not necessarily preclude removal of the glass tube; nothing in the language requires that the tube serve as the cladding, as it is possible, for instance, to form glass coating layers with refractive index gradients so that two layers with different refractive indices could be formed in addition to the glass tube. *See,* e.g., MacChesney 816 Patent, Col. 3, ll. 15-24. Accordingly, the specification does not support the proposition that the preform made according to the claimed process (and mentioned in the preamble and last step of claims 1, 4 and 7) must necessarily include the tube or glass tube used to start the process (and mentioned in the first step of claims 1, 4 and 7).

The term "draw tower" does not appear in any MacChesney 816 Patent claims, nor is there is language in any of the MacChesney 816 Patent claims, specification or prosecution history referenced by either of the parties which requires that the preform must be "loaded into a draw tower." The specification and claims do not include the words "loaded" or "tower," nor do the Sterlite Parties refer to any portion of the prosecution history that contains these words or any basis for importing them into the MacChesney 816 Patent claims. Even if the MacChesney 816 Patent specification referred to a draw tower, it cannot be used as a source from which to read limitations into the claims unless the language of the claims invites reference to those sources. Johnson Worldwide, 175 F.3d at 989-90.

The Sterlite Parties cite to a deposition transcript of Dr. MacChesney and other extrinsic evidence in addressing the meaning of "preform," but that evidence is not useful here in helping determine what a person of ordinary skill in the art would understand "preform" to mean. Phillips, 415 F.3d at 1319. FN1

FN1. The parties have not briefed or entered evidence in these proceedings which would characterize a person having ordinary skill in the relevant art, nor the nature or level of such skill; this document does not characterize such a person or such skill and does not employ any such specific characterization.

In accordance with the foregoing, "preform" is interpreted to mean:

**"Preform": A glass structure, including a tube or rod made from the claimed process, from which an optical fiber may be drawn. The preform need not include the tube or glass tube used to initiate the claimed process (and mentioned in the first step of claims 1, 4 and 7).**

The term "solid" is construed to mean the following:

**"Solid": The preform is not hollow and has been substantially collapsed.**

**2. "Predetermined length"**

Furukawa proposes that the term "predetermined length," which characterizes the glass tube that is used to initiate the claimed process of independent claims 1, 7, 9 and 15, should be interpreted to mean the following:

The hollow glass tube includes a known length (not necessarily its total length) that is at least as long as the

preform intended to be made.

Furukawa Opening Brief, p. 27.

The Sterlite Parties propose the following:

"Having a predetermined length" refers to a characteristic of the "hollow glass tube" and that this tube has a length that is (1) determined before the claimed process begins and (2) remains unchanged throughout the practice of the process.

Sterlite Opening Brief on MacChesney Patent, p. 6, 7.

As a preliminary matter, independent claims 1, 7, 9, and 15 define the "glass tube" as "having" a predetermined length while independent claims 4 and 12 define the glass tube as being "of" a predetermined length. MacChesney 816 Patent, Col. 10, ll. 34, 58; Col. 11, ll. 10-11, 33; Col. 12, ll. 7, 31-32. Additionally, the parties agree that "predetermined" means that the length of the glass tube is known at the time the tube is provided to initiate the claimed process. Sterlite Opening Brief on MacChesney Patent, p. 7.

The Sterlite Parties contend that "predetermined length" also requires that the hollow glass tube length remains unchanged throughout the practice of the claimed process. Sterlite Opening Brief on MacChesney Patent, p. 6, 7. However, all claims of the MacChesney 816 Patent contain language which is inconsistent with absolutely no change in length, in that they prescribe heating and collapsing of the tube into a solid preform which has "substantially the same length as said predetermined length." MacChesney 816 Patent, Col. 10, ll. 41-43; 64-66; Col. 11, ll. 21-23; 42-45; Col. 12, ll. 15-18; 42-44. Thus, even if the glass tube referred to in the first step of the claimed process does remain as part of the preform made according that process, and even if none of the glass tube beyond the ends of the desired preform are removed to leave the finished preform, the glass tube need not be precisely the length of the preform made according to the claimed process.

The Sterlite Parties quote and rely on language from the prosecution history of the MacChesney 816 Patent for the proposition that the preform made according to the claimed process must be the same length as the glass tube used to start the process. Sterlite Opening Brief on MacChesney Patent, p. 8. There, the Patent Office had rejected claims which ultimately became claims 1, 4 and 7 as lacking support in the specification for the heating and collapsing step and the preform resulting from the claimed process. Id. Applicants argued that such disclosure was found in parts of the drawings and specification that referred to or inherently showed that a glass tube of finite and predetermined length was used in the process. Accordingly, the Sterlite Parties infer, the preform has to be the same length as the glass tube. Id. However, the claim language defining the heating and collapsing step that applicants were defending in their argument to the Patent Office in fact only required, as it does in the form of the issued claims 1, 4 and 7, that the preform has "substantially the same length" as the predetermined length. Accordingly, there is no requirement that the length of the glass tube remain fixed or unchanged during the process.

Although the Sterlite Parties do not take express issue with Furukawa's proposed definition that the glass tube used to initiate the claimed processes "*includes*" a known length rather than "constitutes" a known length, the MacChesney 816 Patent specification supports the proposition that not all of the entire length of the glass tube is required to be contained in the preform made according to the claimed processes. FIG. 2 and corresponding text at Col. 4, ll. 32-37 show end portions of the glass tube held or captured by chucks to

hold the tube in a glass lathe to carry out the process. Those chucks correspond to numerals 21 and 22 in FIG. 2. A ring burner (numeral 23) is shown there to traverse and heat the tube (numeral 20) to carry out the process. Neither party has pointed to any disclosure or theory which suggests how the ring burner would traverse or heat the part of the glass tube held by the chucks (numerals 21, 22), so as to make it possible to coat or collapse that part of the tube to form a preform according to the claimed process. MacChesney 816 Patent, Col. 4, ll. 32-37. It may be possible, for example, that such uncoated and uncollapsed portions of the tube may be removed in creating a finished preform, though that removal is not recited in the claim as it does not need to be, the claims being stated in open form and thereby allowing other steps to occur in accused processes without vitiating potential coverage of such processes. AFG Indus., Inc. v. Cardinal IG Co., 239 F.3d 1239 (Fed.Cir.2001).

In view of the foregoing, the term "predetermined length" is interpreted to mean:

**"Predetermined length": The hollow glass tube includes a known length, which is not necessarily its total length, that is at least as long as the preform made according to the claimed process.**

**3. "In unreacted dry vapor form"**

Furukawa submits that "in unreacted dry vapor form," which characterizes the material that is introduced into the bore of the hollow glass tube during the claimed processes of independent claims 1 and 9, means the following:

At least two compounds or molecules which are in a vapor or gaseous state and which have not yet reacted with each other and which do not include substantial amounts of hydrogen or other water-forming compounds.

Furukawa Opening Brief, p. 28.

The Sterlite Parties propose the following:

"Dry vapor" refers to a gaseous material devoid of hydrogen that forms a glass layer. "Unreacted" means the reaction between the constituents of the "dry vapor" has not occurred when the "dry vapor" is introduced into the bore formed through the tube.

Sterlite Opening Brief on MacChesney Patent, p. 9.

As a preliminary matter, the word "dry" is not used in the specification of the MacChesney 816 Patent. However, on the day the application for the MacChesney Patent was filed, July 26, 1983, a "Preliminary Amendment under Continuation Application 37 C.F.R. 1.60" was also filed. That preliminary amendment copied claims from a third party patent into the application in order to provoke the interference proceeding in the Patent Office referred to in the second paragraph at the beginning of this Section III. That preliminary amendment introduced new claim 6 (now claim 1) which contained the term "in unreacted dry vapor form." Furukawa Opening Brief, Ex. 7, p. 1.

That preliminary amendment states the following to show that this claim element was properly supported by the specification:

Support for introducing into the bore a dry vapor that forms a glass layer is shown, for example, on page 9, lines 17-21 where it is indicated that gases such as hydrides and chlorides which react with oxygen to produce "the required oxidic glass" are useful and on page 6, lines 14-16 where it is indicated that such a gaseous material is introduced into the tube.

Id. at 3.

The language at page 9, lines 17-21 (which correspond to MacChesney 816 Patent, Col. 5, ll. 57-61) only state, however, that examples were carried out using chlorides and hydrides, and that other gaseous materials of sufficient vapor pressure under processing conditions which react with hydrogen or oxygen bearing material to produce the required oxidic glass may be substituted. More specifically, that language does not characterize all such examples as using dry vapor. Furukawa Opening Brief, Ex. 6, 3, 9; lines 17-21; MacChesney 816 Patent, Col. 5, ll. 57-61.

Two of the four examples recited in the MacChesney 816 Patent specification involve reaction of hydrides (Examples 2 and 3), while the other two involve reaction of chlorides (Examples 1 and 4). Id. at Col. 8, line 38-Col. 10, line 29.

The MacChesney 816 Patent specification distinguishes its inventive MCVD processes from conventional "soot" processes in which precursor materials are introduced into a flame to form glassy particles within the flame for depositing on a rod or tube. MacChesney 816 Patent, Col. 2, ll. 15-26. These soot processes involve a combustion environment so that "hydration is inevitable" which "gives rise to the well-known water absorption peaks with their related subharmonics so consequential in various portions of the infrared spectrum." Id. at Col. 2, ll. 36-41. In the MacChesney MCVD process, by contrast, hydration "may be minimized." Such hydration minimization yields advantages when the fiber is operated in several portions of the infrared spectrum where light propagation losses in the infrared spectrum accrue due to subharmonics of the fundamental $H_2O$ absorption. Accordingly, "water vapor may, therefore, be a particularly significant impurity and for many purposes, should be kept to a level below a few ppm by volume." MacChesney 816 Patent, Col. 6, ll. 54-61.

Furukawa and the Sterlite Parties concur that Examples 2 and 3 of the MacChesney 816 Patent specification, which involve hydride precursors, do not qualify as compounds or molecules "in unreacted dry vapor form." For example, Furukawa relies only on Examples 1 and 4, and not 2 and 3, as examples that do not include substantial amounts of hydrogen or other water forming compounds. Furukawa Opening Brief, p. 29; Sterlite Opening Brief on MacChesney Patent, pp. 10, 11.

The parties differ, however, on whether *any* hydrogen or water-forming compound can be contained in the "dry vapor." Furukawa Opening Brief, pp. 28-30; Sterlite Parties Opening Brief on MacChesney Patent, pp. 9-11; Furukawa Response Brief, pp. 10-11; Sterlite Response Brief, pp. 7-9.

FIG. 4 of the MacChesney 816 Patent is a plot which shows losses in multi-mode fiber prepared in accordance with "an example" in the patent, although the particular example is not expressly identified. MacChesney 816 Patent, Col. 3, ll 61-65; Col. 4, ll. 55-63. Accordingly, although the plot shows losses at characteristic subharmonics of the fundamental water absorption ( Id. at Col. 4, ll. 61-63), it is not clear whether the fiber was prepared using chloride or hydride precursors. Nevertheless, even though Examples 1 (which uses a chloride precursor) and 3 (which uses a hydride precursor) are dissimilar in many respects, Example 3 fiber suffers losses of 3 decibels per kilometer at 1.06 micrometer (1060 nanometer) wavelength

for fiber formed using the hydride precursors, while such losses are not completely absent in the chloride-precursor formed fiber of Example 1 where losses at the 1060 nanometer wavelength are 2 decibels per kilometer. MacChesney 816 Patent, Col. 8, ll. 50-54; Col. 9, ll. 44-46. Such losses are not inconsistent with the notion that water vapor may be present, but not sufficient to create a "significant impurity." MacChesney 816 Patent, Col. 6, ll. 54-61. Additionally, the specification nowhere requires complete removal of hydrogen, but rather discloses in terms of minimizing hydration and (for many purposes, but not necessarily all purposes) keeping water vapor to a level below a few ppm (parts per million) by volume. MacChesney 816 Patent, Col. 6, ll. 54-61. In view of the foregoing, "in unreacted dry vapor form" is interpreted to mean the following:

**"In unreacted dry vapor form": At least two compounds or molecules which are in a vapor or gaseous state and which have not yet reacted with each other, and which do not include substantial amounts of hydrogen or other water-forming compounds.**

**4. "Thermally Depositing"**

Furukawa proposes that "thermally depositing" as used in independent claims 1 and 9 should be interpreted to mean:

Deposition or accumulation on a surface as a result of elevated temperature.

Furukawa Opening Brief, p. 30.

The Sterlite Parties propose that "thermally depositing" be interpreted to mean:

Depositing material on the inner walls of the tube via thermophoretic processes.

Sterlite Opening Brief on MacChesney Patent, p.12.

The MacChesney Patent discusses at length how to carry out deposition of material on the tube. It uses terms such as "sufficient reaction temperature," "hot zone," and "high temperatures." MacChesney 816 Patent, Col. 4, line 65-Col. 5, line 35. Nowhere, however, does the MacChesney 816 Patent specification mention or refer to "thermophoretic" processes, suggest that such deposition is occurring according to such a phenomenon or exclusively to such a phenomenon, or otherwise use the term "thermophoretic."

The abstract of the MacChesney 816 Patent, which appears on the face page of the patent, includes this general statement about how matter is deposited on the tube:

Flow rates and temperature are sufficient to result in glass formation in the form of particulate matter on the inner surface of the tube. The particulate matter deposits on the tube and is fused with each passage of the hot zone.

FIG. 1 and accompanying text show apparatus suitable for practice of the "deposition process in accordance with the invention," in which a hot zone identified in the drawing by numeral 3 is produced by heating means (numeral 4) which moves relative to the tube (numeral 2) as schematically shown by double-headed arrow (numeral 5A). MacChesney 816 Patent, Col. 3, ll. 53-55; Col. 4, ll. 1-23.

FIG. 2 and accompanying text show a ring burner (numeral 23) as the means for producing the traversing hot zone. Id. at Col. 4, ll. 32-37.

FIG. 3 and accompanying text show an elevational view of a section of a tube (numeral 30) "as observed during deposition." Id. at Col. 4, ll. 40-41. The text characterizes FIG. 3 as follows:

Depicted is a heating means 31 producing a hot zone 32 which is traversing tube 30 in the direction shown by arrow 33 ... [R]egion 36 ... defines the region within which fusion of deposited material is occurring.

Id. at Col. 4, ll. 40-54. MacChesney 816 Patent Col. 4, line 65-Col. 5, line 35 generally discusses vapor deposition according to the invention, and Examples 1-4 recited in the specification disclose the traversing hot zone and temperatures for preparation of preforms according to those examples. Id. at Col. 8, line 37-Col. 10, line 29.

Exemplary of the most specific disclosure the MacChesney 816 Patent specification offers about how the deposition process occurs is the following:.

[P]rocedures of this invention rely upon significant homogenous reaction. In general, 50 percent or more of reaction product is produced in a position removed from substrate surface and results in the formation of solid oxidic particles of the desired glass composition. These particles are similar to those produced during the "soot" process.

MacChesney 816 Patent, Col. 5, ll. 2-8.

Apart from the fact that the term "thermophoretic" does not appear in the prosecution history or the specification, and has not been cited by the Sterlite Parties as appearing in the references cited in the prosecution history, the MacChesney 816 Patent disclosure about how material is deposited on the tube is more general and thus inconsistent with reading into the claims the limitation that any such deposition must be "thermophoretic."

The Sterlite Parties rely upon deposition testimony of Dr. MacChesney which recently occurred in this litigation and another patent, U.S. Patent No. 4,263,032, whose priority date of October 1, 1979 is after the priority date of the MacChesney 816 Patent (February 22, 1974), for the proposition that deposition on the walls of the tube occurs according to the phenomenon of "thermophoretic deposition." Sterlite Opening Brief on MacChesney 816 Patent, pp. 13-16. Nothing in that extrinsic evidence, which occurs subsequent to the priority date of the MacChesney 816 Patent, even if it helps explain one way thermal deposition is occurring according to the MacChesney 816 Patent specification, constitutes a basis for importing a "thermphoretic" limitation into the meaning of "thermally depositing." Such extrinsic evidence can be less reliable than the patent and its prosecution history in determining how to read claim terms, since among other things such evidence does not have the specification's virtue of being created at the time of patent prosecution and for the purpose of explaining the purpose of explaining the patent's scope and meaning. Phillips, 415 F.3d at 1318. It is error to rely upon evidence extrinsic to the patent record in order to alter the meaning of claims which can be ascertained from the intrinsic record. Markman v. Westview Instruments, Inc., 52 F.3d 967, 981 (Fed.Cir.1995), *aff'd,* 517 U.S.370 (1996); Vitronics Corp. v. Conceptronic, Inc., 90 F.3d, 1576, 1584.

The word "thermal" is used in the specification once and in a way that is consistent with elevated

temperature. *Id*. at Col. 5, ll. 32-35. (The term "thermally depositing" also appears in claim 6 of the Preliminary Amendment under Continuation Application 37 C.F.R. 1.60 filed with the MacChesney Patent application on July 26, 1983.) Furukawa Opening Brief, Ex. 7, p.1.

In accordance with the foregoing, the term "thermally depositing" is interpreted to mean the following:

**"Thermally depositing": Deposition or accumulation on a surface as a result of elevated temperature.**

**5. "Said material"**

Furukawa proposes that "said material" which is thermally deposited according to the processes of independent claims 1 and 9 should be interpreted to mean the following:

The reactant material introduced into the bore, whether in unreacted form or in its reactive form after heating in the tube.

Furukawa Opening Brief, p.32.

The Sterlite Parties propose the following:

Sterlite proposes that the Court interpret "said material" to refer to the same "material" referenced in the phrase "material that forms a glass layer" that is recited earlier in claims 1 and 9.

Sterlite Opening Brief on MacChesney Patent, p.16.

The phrase to which the Sterlite Parties refer for defining "said material," reads as follows: "introducing into said bore [of the hollow glass tube used to initiate the claimed process], in unreacted dry vapor form, material that forms a glass layer." MacChesney 816 Patent, Col. 10, ll. 35-37. The Sterlite Parties thus contend that "said material" that is thermally deposited on the tube according to the claimed process is limited to material that is in "unreacted dry vapor form." Sterlite Opening Brief on MacChesney Patent, pp. 16, 17; *see* Section III.B.3 above for interpretation of "unreacted dry vapor form."

Relevant language in the claim states as follows:

Introducing into said bore, in unreacted dry vapor form, material that forms a glass layer, coating said bore by thermally depositing said material thereon to form a glass layer of higher refractive index in the refractive index of the tube.

MacChesney 816 Patent, Col. 10, ll. 35-39. The term "unreacted dry vapor form" precedes "material" in the first part of this language, which is not inconsistent with the notion that such "material" can take forms other than the "unreacted dry vapor form." That inference seems as permissible as concluding that the material can take only one form, the unreacted dry vapor form. However, reading the claim language in context, the first reference to "material" states "introducing into said bore, in unreacted dry vapor form, material that forms a glass layer" which is then followed by "coating said bore by thermally depositing said material thereon to form a glass layer ..." Accordingly, the context of the claim language indicates that the "material" can take various forms, including unreacted as well as other forms which can be or are thermally deposited.

Disclosure in the MacChesney 816 Patent specification is also consistent with "said material" which is deposited in the bore being in some form other than "*unreacted* dry vapor form," such as reacted or partially reacted form. For instance, the first three sentences of the Abstract, which appears on the face page, disclose what is happening in the claimed process, namely the "unreacted" materials chemically react during the process to result in thermally deposited particles:

A preform for fabrication of a glass fiber optical transmission line is prepared by chemical reaction of vapor ingredients within a glass tube. Reaction, which may be between chlorides or hydrides of, for example, silicon and germanium with oxygen, occurs preferentially with a constantly traversing hot zone. Flow rates and temperature are sufficient to result in glass formation in the form of particulate matter on the inner surface of the tube.

MacChesney 816 Patent, Abstract, ll. 1-9. *See also* Id. at Col. 2, line 53-Col. 3, line 50; Col. 4, line 64-Col. 10, line 29.

This interpretation is also consistent with the Sterlite Parties' argument regarding the term "thermally depositing" where Dr. MacChesney is quoted for the proposition that soot is formed and then deposited, although little or no weight is given that testimony in this proceeding for the reasons mentioned above. Sterlite Opening Brief on MacChesney Patent, pp. 13, 15.

The specification of the MacChesney 816 Patent discloses that various reactant materials, sometimes referred to as "gaseous material" "source material" or "liquid reactant material" are introduced in the tube and that "material" also exits the tube during the process. *See, e.g.,* MacChesney 816 Patent, Col. 2, ll. 13, 16; Col. 3, ll. 9, 12; Col. 4, ll. 8, 9, 10, 14, 19, 37, 39, 44. In particular, Col. 4, ll. 50-54 state the following, referring to FIG. 3 of the Patent:

Zone 35 downstream of hot zone 32 is filled with a moving powdery suspension of particular oxidic material, while region 36, devoid of such particulate matter, defines the region within which ***fusion of deposited material is occurring.***

(Emphasis supplied.) The specification thus contemplates that the material can be in unreacted form, deposited form, or in another form that exits the tube. The MacChesney 816 Patent also provides examples in which the matter which is deposited using the reactant materials is referred to as a "material," including "cladding materials" and "core materials." MacChesney 816 Patent, Col. 7, line 26; Col. 8, ll. 39-40, 43-46.

Taking the claim language in context, ACTV, Inc. v. Walt Disney Co., 346 F.3d 1082, 1088-90 (Fed.Cir.2003), and otherwise in view of the foregoing, the term "said material" is interpreted to mean:

**"Said material": The material introduced into the bore of the glass tube, whether in unreacted form or other forms including those that form a glass layer.**

**6. "Having substantially the same length as said predetermined length"**

Furukawa proposes that this term, which relates to the length of the "solid preform" that is made according to the claimed process of claims 1 and 9, and compares that length to the length of the tube mentioned at the beginning of the claim that is used to begin the claimed process, should be interpreted as follows:

The preform has a length that is equal to most (more than half) of the known length of the hollow glass tube.

Furukawa Opening Brief, p. 34.

The Sterlite Parties propose the following:

Sterlite proposes that the Court interpret "having the substantially the same length as said predetermined length" to refer to the length of the "solid preform" measured from one end to the other. The length of the preform must also be "substantially the same" as the "predetermined length" of the "hollow glass tube" interpreted ... above.

Sterlite Opening Brief on MacChesney Patent, p.17.

As recognized in Section III.B.2 above, independent claims 1, 7, 9, and 15 define the "glass tube" which is used to begin the claimed process as "having" a predetermined length while independent claims 4 and 12 define the glass tube as being "of" a predetermined length. MacChesney 816 Patent, Col. 10, ll. 34, 58; Col. 11, ll. 10-11, 33; Col. 12, ll. 6, 31-32. Each of the claims, however, requires:

Heating said ***coated*** tube to collapse said tube into a solid preform having substantially the same length as said predetermined length.

MacChesney 816 Patent, Col. 10, ll. 41-43, 63-66; Col. 11, ll. 21-23, 43-45; Col. 12, ll. 15-17, Col. 15, ll. 42-44 (emphasis supplied).

As discussed above in Section III.B.2, which interprets "predetermined length" of the tube used to begin the claimed process, there is no requirement in the MacChesney 816 Patent specification that the entire length of that tube, referred to in the first step of claims 1, 4 and 7, must be coated and collapsed to form the preform. FIG. 2 and accompanying text, for example, disclose securing the tube to the coating apparatus using chucks and suggest embodiments in which heating the entire tube is physically not possible. MacChesney 816 Patent, FIG. 2; Col. 4, ll. 24-39. It is true that Col. 8, ll. 3-8 say that every portion of the tube should be heated for the same period of time, and that this can be accomplished easily by passing the heating means through a traversal distance which extends "beyond the tube at both ends." However, this reference to the "tube" is not in any event inconsistent with being considered as a reference to the relevant part of the tube that is coated and collapsed according to the claimed process to make the preform. MacChesney 816 Patent, Col. 8, ll. 3-8.

Additionally, the Summary of the Invention Section of the MacChesney 816 Patent specification discloses the depositing process to coat the tube and then that preforms can be prepared "by conventional processing from the deposited product to a final configuration" which may be of a rod shape and of a length of 18 inches. MacChesney 816 Patent, Col. 3, ll. 34-40. As recognized in Section III.B.2, such further processing, including potential removal of uncoated or other portions of the tube to form the finished preform, need not necessarily be recited in the claim. AFG Indus., Inc. v. Cardinal IG Co., 239 F.3d 1239 (Fed.Cir.2001).

The prosecution history of the MacChesney 816 Patent includes a memorandum prepared by one of the inventors, and dated before the priority date of the MacChesney 816 Patent, which is consistent with the notion that the preform need not constitute the entire length of the initially provided glass tube. That

memorandum discloses forming the deposit and thus coating the tube over only 12 inches of a 24 inch long tube. Furukawa Opening Brief, Ex. 19, "Memorandum for File," p. 3.

The Federal Circuit has construed the term "substantially" as a term of approximation or as a term of magnitude. *See* Deering Precision Instruments, LLC v. Vector Distrib'n Sys., Inc., 347 F.3d 1314, 1322-23 (Fed.Cir.2003), *cert. denied,* 540 U.S. 1184 (2004). The MacChesney 816 Patent claims use "substantially" to mean approximation, since those claims characterize one length as "substantially the same" as the other. In this sense, substantially means significantly or essentially. Id. at 1322-23.

In view of the foregoing, the term "substantially the same length as said predetermined length" is interpreted to mean as follows:

**"Having substantially the same length as said predetermined length": The length of the preform made according to the claimed process does not differ significantly from the length of that portion of the tube referred to in the first step of claims 1, 4 and 7 which is coated and collapsed according to the claimed process, or if the entire length of the tube referred to in the first step of claims 1, 4 and 7 is coated and collapsed according to the claimed process, then the length of the preform made according to the claimed process does not differ significantly from the length of the tube referred to in the first step of claims 1, 4 and 7.**

**7. "Vapor mixture including at least one compound glass-forming precursor-together with an oxidizing medium"**

This term refers to a mixture that is introduced into a tube during the claimed process of independent claims 4 and 12 of the MacChesney 816 Patent. Furukawa proposes that it should be construed to mean as follows:

A mixture of at least two compounds or molecules which are in a dry vapor or gaseous state, which mixture includes at least one reactant containing silicon and also includes at least one reactant containing an oxidizing medium.

Furukawa Opening Brief, p. 37.

The Sterlite Parties propose as follows:

Sterlite proposes that the Court interpret "vapor mixture including at least one compound glass-forming precursor together with an oxidizing medium" to refer to a homogenous mixture of vapor or gaseous constituents. The constituents include at least one "glass-forming precursor" which is a material such as chlorides or hydrides of silicon that when combined appropriately with oxygen reacts to form glass. The constituents must further include an oxidizing medium. Finally, the constituents must also include a dopant material for increasing the refractive index such as germanium, titanium, aluminum, or phosphorus.

Sterlite Opening Brief on MacChesney Patent, p. 20.

The specification does not include the terms "glass-forming precursor" or "oxidizing medium" nor do the parties point to use of such terms in the prosecution history. Nor are the terms "oxidizing" or "oxidize" employed in the specification or pointed to in the prosecution history by any of the parties. However, the specification does disclose fabrication of glass fibers in which "gas phase precursor reactants together with

oxygen are introduced into a glass tube." MacChesney 816 Patent, Col. 2, ll. 55-58. Reactant materials include "chlorides and hydrides, as well as other compounds which will react with oxygen as described." Id. at Col. 3, ll. 9-11. Reactants can also take the form of dopants. Id. at Col. 3, ll. 17-20. The specification discloses that a first layer may be formed of (among other possibilities) "undoped silica" which can act as part of the clad. Id. at Col. 5, ll. 62-68. Compounds which may replace oxygen include nitrous oxide, nitric oxide, and carbon dioxide. Id. at Col. 6, ll. 40-42.

The parties appear to differ on three issues: (1) whether the term should be limited to homogeneous mixtures; (2) whether it should be limited to dry vapor mixtures; and (3) whether it should require inclusion of a dopant material for increasing the refractive index, such as germanium, titanium, aluminum or phosphorous. Furukawa Opening Brief, p. 37; Sterlite Opening Brief on MacChesney Patent, p. 20.

**a. "homogeneous mixtures"**

The MacChesney 816 Patent specification refers repeatedly to homogenous reactions and in two cases to homogeneous glassy layers, but not to homogenous mixtures. *See, e.g.,* MacChesney 816 Patent, Col. 2, ll. 18, 59, 62; Col. 5, ll. 3, 9, 12, 52; Col. 7, ll. 19, 59, 68. None of the parties have proposed that the reaction according to the claimed process is limited by this claim language to being a homogenous reaction, and that issue is not addressed here. The Sterlite Parties have pointed to no disclosure in the specification, prosecution history or references cited in that prosecution history for importing the homogeneous limitation into this claim term. Accordingly, it is improper to import the "homogeneous" limitation into the claim in this case with reference to the word "mixture" as proposed by the Sterlite Parties. Johnson Worldwide, 175 F.3d at 989.

**b. "dry vapor mixtures"**

Although Furukawa points to portions of the MacChesney 816 Patent specification which disclose reaction of chlorides that are recognized to be in dry vapor form to support the notion that this claim term should be limited to dry vapor, Examples 2 and 3 of the specification disclose reaction of hydrides, which are not in dry vapor form as recognized in Section III.B.3 above. Furukawa Opening Brief, p. 37-38 (citing MacChesney 816 Patent specification, Col. 7, ll. 25-29, Col. 8, ll. 39-46 (Example 1) and Col. 9, line 60 (Example 4)). ( *Compare* Id. at Col. 8, line 57-Col. 9, line 46 (Examples 2 and 3)). Although independent claims 1, 7, 9, and 15 do include express reference to term "dry vapor" and thus include such a limitation, no basis is found for reading that limitation into independent claims 4 or 12.

**c. "dopants"**

The MacChesney 816 Patent specification discloses various reactants which can form glass, including chlorides, hydrides and other compounds of silica, as well as reactants for forming dopants, which do not contain silicon. *See, e.g.,* MacChesney 816 Patent, Col. 1, line 65-Col. 2, line 7. The claim language requires "at least one" glass forming precursor, which when taken in context does not rule out that precursor being a non-dopant ( *e.g.,* silicon) or necessarily mean that the precursor must in any case be a dopant. For instance, in Examples 1-4 of the MacChesney 816 Patent, the vapor mixture introduced into the tube always contains a precursor that includes silicon, but not always a precursor that includes a dopant. MacChesney 816 Patent, Col. 8, line 36-Col. 10, line 29; *see* more particularly Id. at Col. 9, ll. 29-33 (where simply silane and oxygen are introduced into the tube). Instead, the precursor can as easily or more easily constitute silicon. Accordingly, there is no requirement that this term defines a mixture which must include a dopant material.

In view of the foregoing, the term "vapor mixture including at least one compound glass-forming precursor together with an oxidizing medium" is interpreted to mean the following:

**"Vapor mixture including at least one compound glass-forming precursor together with an oxidizing medium": A mixture in a vapor or gaseous state which includes at least a first reactant which forms glass, and a second reactant which is oxygen bearing and which oxidizes or reacts with the first reactant to form glass. The first reactant need not contain a dopant, the mixture need not be "homogeneous" and the mixture need not constitute a "dry vapor."**

**8. "Chemically reactive in the process of heating to form glass substantially similar to that of said glass core"**

This term refers to the vapor that is introduced into the glass tube during the claimed process of independent claims 7 and 15. Furukawa submits that it should be interpreted to mean the following:

A vapor or gaseous substance containing at least two reactants undergoing a chemical reaction after elevating the temperature of the substance which results in formation of a glass having a refractive index that is significantly similar to the refractive index of the glass core.

Furukawa Opening Brief, p. 38.

The Sterlite Parties join in that interpretation. Sterlite Opening Brief on MacChesney Patent, pp. 22-23. Accordingly, that interpretation is adopted here and the term "chemically reactive in the process of heating to form glass substantially similar to that of said glass core" is interpreted to mean the following:

**"Chemically reactive in the process of heating to form glass substantially similar to that of said glass core": A vapor or gaseous substance containing at least two reactants undergoing a chemical reaction after elevating the temperature of the substance which results in formation of a glass having a refractive index that is significantly similar to the refractive index of the glass core.**

**9. "Localized hot zone"**

The term "localized hot zone" appears in independent claims 7 and 15. Furukawa proposes that it be interpreted to mean the following:

A region of the interior of the glass tube (not necessarily extending the entire length of the glass tube) having an elevated temperature which is caused by the heating means.

Furukawa Opening Brief, p. 39.

The Sterlite Parties propose as follows:

Sterlite proposes that the Court interpret "localized hot zone" to refer to an area in the interior of the glass tube and generally depicted as "hot zone 3" on FIG. 1 of the '816 Patent. The "localized hot zone" does not extend over the entire length of the glass tube but rather extends over a length of 2 cm to 4 cm of the tube. Instead, it is limited to the area in the interior of the glass tube immediately adjacent the portion of the glass tube that is heated to at least 1200 (deg.) C but not more than 1600 (deg.)C.

The term "localized" does not appear in the specification of the MacChesney 816 Patent, although the term "hot zone" is used throughout the specification including twice in the abstract. For instance, FIG. 1 is said to show a "hot zone" (numeral 3) produced by a heating means (numeral 4) which traverses the tube (numeral 2) by movement of the heating means. MacChesney 816 Patent, Col. 4, ll. 1-7. In FIG. 2, the "hot zone" is said to be produced within tube (numeral 20) by means of a ring burner (numeral 23) which is caused to constantly traverse the tube in the direction depicted by the double-headed arrow (numeral 24). Id. at Col 4, ll. 33-37. In FIG. 3, a heating means (numeral 31) produces a "hot zone" (numeral 32) which is traversing tube (numeral 30) in the direction of the arrow (numeral 33). Col. 5 of the specification, at lines 9-35, discloses multiple variables involved in the processes, in which the temperature and dimensions of the hot zone are but two. Those include traversal rate of the hot zone, rotation of the tube, temperature of the hot zone, reactant flow rate, and the reactants. This portion of the specification discloses that FIG. 1 shows a hot zone of approximately 2 cm length which moves at a rate of about 45 cm per minute at a temperature of 1600 (deg.) C without harmful tube distortion. However, length of the hot zone can be decreased, rate of rotation can be increased, reactant flow rate can be increased, and vertical disposition of the tube can occur which can permit use of higher maximum temperatures without variation in the tube geometry, as an example. Id. at Col. 5, ll. 20-35. Column 4, at lines 25-30, discloses that vertical disposition of the tube can lend stability to the portion of the tube within the hot zone and thus permit attainment of higher temperatures or of longer hot zones in the traversal direction without objectionable distortion.

Col. 7, line 62-Col. 8, line 16 discuss the hot zone in greater detail. Among other things, that portion of the specification says that in general, it is desirable to maintain the hot zone as short as possible depending upon constancy of the traversal speed to result in uniform layer production. Additionally, motion of the hot zone should be such that every portion of the tube is heated to the zone temperature for the same period of time. The text notes that experimentally, hot zones on the order of 2 cm in length have resulted in uniform coating under experimental conditions but that in principle, heating the entire tube may result in uniformity of deposition approaching that attained by that of a moving zone, even if very high flow rates of reactants would be required and different thicknesses of deposit may occur along the length of the tube. MacChesney 816 Patent, Col. 7, line 62-Col. 8, line 16.

The four examples disclosed in the specification are said to have used a "moving oxyhydrogen torch" to produce the hot zone, though dimensions of the torch, the flame, or the hot zone were not disclosed. Id. at Col. 8, ll. 28-32.

Example 2 and Examples 3 are the only portions of the specification which disclose heating using a form of "local." Example 2 states:

Deposition commenced by heating the tube *locally* using an oxyhydrogen flame which was traversed along the length of the tube.

Id. at Col. 8, ll. 65-67.

Example 3 discloses the following:

Deposition commenced by heating the tube *locally* using an oxyhydrogen torch which traversed along the tube at a rate of .10 cm/sec as the tube rotated at 100-120 rpm. The torch was adjusted so as to produce a

temperature *locally* of 1375-1450 (deg.) C.

Id. at Col. 9, ll. 21-25.

Those two examples involve reaction of hydrides, while Examples 1 and 4, which do not include use of a form of "local" to characterize the heating, involve reaction of chlorides. Yet the paragraph immediately preceding the four examples which generally describes certain procedures used in the examples, discusses use of the same instrumentality to conduct the heating: a moving oxyhydrogen torch. Id. at Col. 8, ll. 28-32. Neither party has shown or suggested why use of the word "local" in Examples 2 and 3 but not 1 and 4 affects the meaning of "localized" to characterize the hot zone in claims 7 and 15, or why such use would mean that such usage constitutes a basis to import a dimensional limitation on the hot zone into claims 7 and 15.

Claims 7 and 15 use the term "localized hot zone" in the context of two steps:

Establishing a localized hot zone in the interior of said glass tube to react vapor within said hot zone [and]

Moving said hot zone longitudinally along substantially the same length as said glass tube to coat a layer of glass ... on the inside wall of said glass tube.

Id. at Col. 11, ll. 14-19; Col. 12, ll. 34-39.

By contrast claims 5 and 12 use the term "hot zone" without the "localized" modifier in the context of one step:

Heating the tube and contents by a moving hot zone produced by a correspondingly moving heat source external to the tube so as to react the said mixture and produce a glassy layer on the inner surface of the tube.

Id. at Col. 10, ll. 58-62; Col. 12, ll. 8-12.

The differences in these uses have not been addressed by either of the parties expressly, or to show that any dimensional limitation on the hot zone should be imported into claims 7 and 15. In any event, exclusion of the term "localized" in claims 5 and 12 does not imply a dimensional limitation created by that word in claims 7 and 15 when other such differences exist.

Nowhere in the extensive disclosure relating to creation and use of the hot zone during practice of the patented invention is there stated or implied a particular dimensional limitation on the size of the hot zone as necessary or critical to practice of the invention, or in a way that might otherwise constitute a basis for importing such a dimensional limitation into the claim term. Nor have the Sterlite Parties shown such use in the prosecution history. Johnson Worldwide, 175 F.3d at 989-90.

With respect to any temperature limitations associated with uses of "localized hot zone" in claims 7 and 15, the specification discusses (in addition to portions cited above in this section) using temperatures outside the range of temperatures proposed by the Sterlite Parties, including at Col. 9, ll. 3-5 (Example 2); 31-32 (Example 3). It is true that a general discussion of a number of factors associated with the inventive processes suggests a minimum of 1200 degrees Centigrade, but only for hot zones "for the usual based silica

systems which constitute the preferred embodiment." *Id*. at Col. 5, ll. 15-20. As to a maximum limit of 1600 degrees proposed by the Sterlite Parties, this section makes clear that temperatures above 1600 may be permitted if length of the hot zone is decreased, rate of rotation of the tube and / or reactant flow rate are increased, or the tube is disposed vertically instead of horizontally. *Id*. at Col. 5, ll. 26-35. Accordingly, there is no basis for importing into this claim term the temperature limitations proposed by the Sterlite Parties. Johnson Worldwide, 175 F.3d at 989-90.

In view of the foregoing, "localized hot zone" is interpreted to mean the following:

**"Localized hot zone": A region of elevated temperature or heat in the interior of the glass tube, which does not necessarily extend the entire length of the glass tube initially provided to begin the claimed process or the entire length of the portion of that glass tube to be coated according to the claimed process, and which is capable of being moved longitudinally with respect to the glass tube to cause coating to occur in accordance with the claim.**

**IV. Hart** 047 Patent **and Hart** 881 Patent **Issues**

The parties differ as to the meaning of four claim terms which appear in the Hart 047 Patent and one claim term which appears in the Hart 881 Patent. The Hart 047 Patent and the Hart 881 Patent are related. The Hart 047 Patent application was filed on August 2, 1992. It contained ten claims, with claims 1-5 and 10 defining methods of making optical fiber and 6-9 defining articles comprising single-mode optical fiber. Applicants elected to pursue the method claims which after prosecution in the Patent Office led to issuance of the Hart 047 patent. The article claims were pursued in a separate line of continuation and divisional applications, which ultimately led to issuance of the Hart 881 Patent. Furukawa Opening Brief, pp. 13-16; Hart 881 Patent, s. [60]. The Hart 881 Patent being a continuation of a divisional of the application from which the Hart 047 Patent issued, the Hart 047 Patent and the Hart 881 Patent contain the same specification and drawings. 35 U.S.C. s. 120; *see* Applied Materials Inc. v. Advanced Semiconductor Materials Am., Inc., 98 F.3d 1563, 1579 (Fed.Cir.1996).

**A. Hart** 047 Patent **Claim Terms**

The Hart 047 Patent contains four claims, independent claim 1 and dependent claims 2-4. Contested words and phrases appear in claims 1 and 4 which are reproduced below:

1. A method of making an optical fiber comprising

a) providing an optical fiber ***preform;***

b) heating at least a portion of said preform; and

c) drawing optical fiber from the heated preform such that a spin is impressed on the fiber; wherein

d) step c) comprises, ***while maintaining the preform rotationally stationary, applying a torque to the fiber, said torque causing the fiber to undergo rotation around the longitudinal axis of the fiber*** such that the spin is impressed on the fiber as it is drawn from the preform, wherein the torque is applied such that ***the spin impressed on the fiber does not have a constant spatial frequency.***

4. Method according to claim 3, wherein applying the torque by means of the guide roller comprises causing

the guide roller to ***oscillate about an axis that is substantially parallel to a fiber draw direction.***

Hart 047 Patent, Col. 6, ll. 12-25, 35-38 (emphasis supplied).

**B. Hart** 047 Patent **Recommended Claim Term Interpretation**

**1. "Preform"**

The parties dispute the meaning of "preform" which appears in claim 1 and thus all claims of the Hart 047 Patent. Furukawa contends that "preform" should be interpreted to mean:

A glass structure from which an optical fiber may be drawn. Furukawa Opening Brief, p. 41.

The Sterlite Parties propose that the term "preform" be interpreted to mean:

The glass structure introduced into a fiber drawing tower from which fiber is drawn.

Sterlite Opening Brief on Hart Patents, p. 4.

The parties thus agree that "preform" should mean a glass structure from which an optical fiber may be drawn, with the exception that the Sterlite Parties propose that the definition should include the requirement that the glass structure is "introduced into a fiber drawing tower."

By way of background, the Hart 047 Patent discloses heating at least a portion of a "conventional optical fiber preform" to a conventional draw temperature and drawing optical fiber from the heated preform in such a way that a spin is impressed on the fiber. Hart 047 Patent, Col. 2, ll. 31-36.

The Hart 047 Patent refers to a "draw tower" at least three times, though such uses are not pointed out or relied on by the Sterlite Party briefing. Id. at Col. 4, ll. 22-26; 47-51; Col. 4, line 67-Col. 5, line 3. The first two uses refer to FIG. 3, which shows guide rollers but does not show a draw tower, and is characterized as showing exemplary structure to practice the invention. Id. at Col. 2, ll. 16-18. The third use notes that the "draw direction" is "typically the same" as the "draw tower axis" which once again does not suggest that use of a draw tower is essential to practice of the Hart 047 Patent invention. Id. at Col. 5, line 1.

The term "draw tower" does not appear in the Hart 047 Patent claims, nor have the parties cited a component shown in the figures which is referred to as a "draw tower." The parts of the affidavit submitted in the Hart 881 Patent application, upon which the Sterlite Parties rely at Sterlite Opening Brief on Hart Patents, p. 4, do not refer to a draw tower. Nothing in the patent specification or prosecution history relied on by Sterlite Parties constitutes a basis for importing into the claim a requirement that a draw tower must be used. Johnson Worldwide, 175 F.3d at 989-90. In view of the foregoing, the term "preform" is interpreted to mean:

**"Preform": A glass structure from which an optical fiber may be drawn.**

**2. "While maintaining the preform rotationally stationary, applying a torque to the fiber, said torque causing the fiber to undergo rotation around the longitudinal axis of the fiber"**

Furukawa proposes that this term should be interpreted to mean the following:

Rotational torque is applied to the fiber which is not overcome by rotational torque applied by the preform.

Furukawa Opening Brief, p. 43.

The Sterlite Parties propose that the term "maintaining the preform rotationally stationary" should mean:

The glass structure from which optical fiber is drawn does not move in a circular pattern during the process of drawing fiber.

Sterlite Opening Brief on Hart Patents, p. 5

The term "stationary" does not appear in the Hart 047 Patent specification, with respect to rotation of the preform or otherwise. The specification does disclose that it is known to produce fiber having low polarization mode dispersion (PMD) by rapidly "spinning the preform" while pulling the fiber from the preform. However, the specification notes that in order to produce one particular fiber with particular favorable characteristics, the preform would need to be spun at 6,000 rpm which is "substantially unsuitable for current commercial fiber production." Hart 047 Patent, Col. 1, line 62-Col. 2, line 2. The specification also notes that the prior art method of spinning the preform "results in a spin of essentially constant pitch." Hart 047 Patent, Col. 2, ll. 52-54.

The term "while maintaining the preform rotationally stationary" was introduced in an amendment filed during the course of prosecution of the Hart 047 Patent, on September 13, 1983. Furukawa Opening Brief, Exhibit 10. That document states as follows:

The instant invention is an improvement over PCT '232 (a prior art document which discloses spinning the preform). The prior art method would at best be difficult to implement with today's draw speeds, since it would require impractically high preform rotation rates. For instance, at page 9, lines 10-14 of PCT '223, it is disclosed that a draw speed of 0.5 m/s requires a preform rotation rate of 300-1500 rpm to achieve a spin pitch of 10-2 cm. Thus, a draw speed of 10 m/s requires a rotation rate of 6,000-30,000 rpm to achieve 10-2 cm spin pitch. This is clearly not practical.

It is submitted that the *only* relevant method of making fiber with impressed spin taught or suggested by PCT '223 is a method that involves spinning the preform ....PCT '223 does indeed disclose the possibility of non-constant spin rate, including oscillating spin. However, the *only* disclosed or suggested means for achieving this involve[s] spinning the preform....There is nothing in PCT '223 that teaches applying, while maintaining the preform rotationally stationary, a torque to the fiber *such that the fiber undergoes rotation around the longitudinal axis of the fiber*. Spinning the preform not only does not cause fiber rotation around the longitudinal fiber axis, due to the presence of easily formable soft glass in the "hot zone," but is now explicitly excluded. Amended claim 1 thus contains features that are not disclosed by PCT '223.

Furukawa Opening Brief, Exhibit 10, p. 3 (emphasis in original).

The document referred to as "PCT '223" is not contained in the record of these proceedings, and is not relied upon by either party in briefing this claim term.

Furukawa characterizes the meaning of the language at the end of the section quoted above, that spinning

the preform not only does not cause fiber rotation around the longitudinal fiber axis, but is now "explicitly excluded," to mean that spinning of the preform is not completely excluded from the claim, but rather is excluded to the extent that such spinning does not cause fiber rotation or impart spin to the fiber. Furukawa points to the part of the specification which addresses that imparting a practical amount of spin to practice the invention by spinning the preform would require spinning the preform at 6,000 rpm. Thus, Furukawa argues, the point is that "maintaining the preform rotationally stationary" means that the impressed spin in the claims, which is of non-constant spatial frequency, is not imparted to the fiber by spinning the preform, but rather by applying the resultant torque to the fiber. Furukawa Opening Brief, pp. 44-45.

The Sterlite Parties argue that the plain meaning of "maintaining the preform rotationally stationary" is that the preform is not rotated during the drawing process that results in the fiber with impressed spin. Sterlite Opening Brief on Hart Patents, p. 5. The Sterlite Parties also rely on the language quoted above which says that "spinning the preform" is "now explicitly excluded" as well as the language that says that "[n]othing in the cited prior art teaches or suggests rotating the fiber along its longitudinal axis while maintaining the preform rotation free." They also rely on extrinsic evidence in the form of deposition testimony given in this litigation by one of the Hart 047 Patent inventors that the "preform is not rotating." Sterlite Opening Brief on Hart Patents, p. 6. The Sterlite Parties thus argue that any form of preform rotation is clearly disclaimed by introduction of this limitation in an effort to overcome the prior art rejection. Sterlite Response Brief, p. 16.

Relevant language in Hart 047 Patent claim 1, in context, states as follows:

(c) drawing optical fiber from the heated preform such that a spin is impressed on the fiber; wherein

(d) step (c) comprises, while maintaining the preform rotationally stationary, applying a torque to the fiber, said torque causing the fiber to undergo rotation around the longitudinal axis of the fiber such that the spin is impressed on the fiber as it is drawn from the preform, wherein the torque is applied such that the spin impressed on the fiber does not have a constant spatial frequency.

This language can be read to suggest that it is the application of torque to the fiber, rather than maintaining the preform rotationally stationary, which causes the fiber to undergo rotation of about its longitudinal axis such that the claimed spin of non-constant spatial frequency is impressed on the fiber. In that sense, the statement that spinning the preform is "now explicitly excluded" could be read to refer back to the language of the amended claim itself, and could be read to mean that what is excluded is spinning the preform as a means for impressing the claimed, non-constant spatial frequency spin on the fiber, even if spinning the preform creates a non-appreciable amount of such spin on the fiber.

In another sense, however, the preform is either held rotationally stationary or it is not, which raises the question, stationary relative to what? First, "rotationally stationary" could be read as stationary relative to a manufacturing apparatus such as the furnace 12 shown in FIG. 1 ( *see* numeral 12), where the preform simply does not rotate at all. However, that interpretation is inconsistent with the fact that nowhere else does claim 1 recite any components of apparatus in which the process is carried out. On the other hand, "stationary" may be interpreted relative to rotation of the fiber about its longitudinal axis which appears in the next line of the claim after "rotationally stationary." That interpretation is consistent with the facts that a form of the word "rotation" is used to modify the word "stationary," and that this usage occurs in the context of a subsequent parallel use of "rotation" in the claim language which requires that "rotation around the longitudinal axis of the fiber" impresses the claimed spin on the fiber, which does not have a constant

spatial frequency. Hart 047 Patent, claim 1, Col. 6, ll. 17-25. In this sense, "rotationally stationary" can be considered relative to the rotation of the fiber about its longitudinal axis as it is drawn from the preform according to the claim.

Interpreting "rotationally stationary" to exclude any significant non-constant spatial frequency spin impressed on the fiber according to the claimed process is consistent with the Hart 047 Patent specification that the speeds at which the preform would need to be spun to yield the spin on the fiber according to the invention would be commercially impracticable. Hart 047 Patent, Col. 1, line 50-Col. 2, line 2. Again, that specification emphasizes that such spin impressed on the fiber aims to "substantially reduce polarization mode dispersion" or PMD in the fiber. Hart 047 Patent, Abstract, ll. 5-8. By inference, any spinning of the preform during practice of the claimed process would not produce any significant amount of such non-constant spatial frequency spin impressed on the fiber according to the process.

In view of the foregoing, the meaning of "while maintaining the preform rotationally stationary, applying a torque to the fiber, said torque causing the fiber to undergo rotation around the longitudinal axis of the fiber" is interpreted to mean as follows:

**"While maintaining the preform rotationally stationary, applying a torque to the fiber, said torque causing the fiber to undergo rotation around the longitudinal axis of the fiber": Torque is applied to the fiber, the torque causing the fiber to undergo rotation around the longitudinal axis of the fiber, and no significant spin is impressed on the fiber by any rotation of the preform.**

**3. "The spin impressed on the fiber does not have a constant spatial frequency"**

Furukawa proposes that this term should be interpreted as follows:

A spin impressed at least part of the fiber which does not have a constant number of spins per meter or reverses direction.

Furukawa Opening Brief, p. 45.

The Sterlite Parties propose the following:

Fiber satisfying this requirement must have an always changing number of spins per meter over the entire length of such fiber.

Sterlite Opening Brief on Hart Patents, p. 7.

The parties seem to agree that the term "spatial frequency" refers to the number of spins over a given distance or per length of fiber, but they differ as to the meaning of a non-constant such spatial frequency as required in the claim term. Furukawa Opening Brief, p. 45; Sterlite Opening Brief on Hart Patents, p. 8. Furukawa contends that the rate of spin along the fiber does not have a constant number of spins per meter, thus does not remain unchanged along the length of the fiber. The Sterlite Parties, on the other hand, interpret the same language to mean that the number of spins per meter is always changing so that there could be no portions with a constant spin. Furukawa Opening Brief, p. 45; Sterlite Opening Brief on Hart Patents, p. 8.

The Sterlite Parties point to portions of the Hart 047 Patent specification which disclose advantages of non-constant spatial frequency or its inverse, pitch, including Col. 3, ll. 5-9, 24-28, 41-44. The Sterlite Parties also point out that the patent applicant knew how to craft a claim, that the claim earlier recites "heating at least a portion of said preform" and that the meaning of "the fiber" accordingly does not refer to a portion of the fiber. Sterlite Opening Brief on Hart Patents, p. 9. The Sterlite Parties also refer to FIG. 6 of the patent which are plots that show constantly, essentially sinusoidally, changing spins per meter or spatial frequencies over an approximate two meter length of fiber. Id. at 9, 10.

The specification refers to not having a "constant spatial frequency" in multiple places, as the Sterlite Parties correctly note. The abstract on the face page of the patent notes that the spin "does not have constant spatial frequency, e. g., has alternately clockwise and counterclockwise helicity." Hart 047 Patent Abstract (face page). At another place, the patent states the following:

In currently preferred embodiments of the invention, the torque is applied intermittently to the fiber, whereby the spin impressed on the fiber has a pitch that is not constant over substantial lengths of the fiber, e. g., is not constant over the beat length Lp. We currently believe that non-constant pitch can have advantages over constant pitch, since low pitch can also couple polarization modes, provided the pitch is precisely matched with the fiber birefringence spatial frequency.

Hart 047 Patent, Col. 3, ll. 1-9.

Furthermore, the Hart 047 Patent specification states:

[I]t is clear that a constant pitch spin will typically not result in efficient mode coupling. On the other hand, non-constant pitch spin, especially spin that has alternately positive and negative helicity, is likely to contain spatial components that produce efficient coupling. We currently believe that strong coupling [and thus favorable reduction of PMD] can be obtained with spin of varying spatial frequency that comprises, in addition to regions of relatively high-spin spatial frequency, regions of relatively low-spin spatial frequency. This is, for instance, the case if the spin alternates between positive and negative helicity.

Id. at Col. 3, ll. 19-30.

Text which refers to FIG. 6 characterizes the spin shown in that plot as "non-constant" and, beyond that, "even having clockwise and counterclockwise helicity." Such spin is said to result in substantial likelihood that the spin comprises a component that is effective in coupling the two polarization modes. Id. at Col. 5, ll. 34-37. Thus, this language and the language quoted above in Column 3 of the Hart Patent indicate that spin which alternates between positive and negative helicity can be considered as a subset of the set of spins with non-constant spatial frequency. This disclosure is consistent with at least these points: (1) Clockwise and counterclockwise helicity, or a spin that alternates between positive and negative helicity, are types of spin that do not have a constant spatial frequency, but not the only types. (2) Varying the spin can be done in multiple ways to achieve the strong coupling and consequent low PMD desired in the invention, including changing the number of spins per meter impressed on the fiber, and / or changing direction of the spin. Id. at Col. 3, ll. 19-30.(3) There is no requirement that the spin is always changing or always changing over the length of the entire fiber. *See, e.g.,* Hart 047 Patent, Col. 3, ll. 1-9(preferred embodiments feature "spin impressed on the fiber [that] has a pitch that is not constant over substantial lengths of the fiber, e.g., is not constant over the beat length Lp"); Col. 3, ll. 41-44 (spin characterized as not being constant "along the fiber" and "at least a portion of the fiber having a spatial spin frequency in excess of four spins/meter").

In view of the foregoing, "the spin impressed on the fiber does not have a constant spatial frequency" is interpreted to mean the following:

**"The spin impressed on the fiber does not have a constant spatial frequency": Along substantial lengths of the fiber, the number of spins per meter impressed on the fiber is not constant.**

**4. "Oscillate about an axis that is substantially parallel to a fiber draw direction"**

Furukawa proposes that this term should be interpreted as follows:

Causing a guide roller to move back and forth about an axis which extends in a direction that is similar to the direction in which the fiber is drawn from the preform.

Furukawa Opening Brief, p. 46.

The Sterlite Parties propose the following:

Application of alternating torque to impress spin on fiber using the guide roller includes the swinging back and forth of the guide roller with a regular uninterrupted motion about an axis defined by a line perpendicular to this page and emanating from the crossing point of the red "X" indicated on FIG. 4 below.

Sterlite Opening Brief on Hart Patents, p. 11.

The parties thus agree that this claim term requires a guide roller to move back and forth about an axis. The specification at Col. 4, line 67-Col. 5, line 3 discloses that the guide roller can be caused to oscillate about an axis that is parallel to the fiber draw direction to impress positive and negative spin on the fiber alternately, referring to FIG. 4. In FIG. 4, the oscillation is by rotation of the guide roller about an axis. FIG. 5 shows an alternate arrangement in which the guide roller is caused to translate back and forth axially. Id. at Col. 5, ll. 8-13. There is no requirement stated or implied in the specification that the movement be regular or uninterrupted. Id. at Col. 3, ll. 1-30.

The requirement that the oscillation be about an axis "substantially parallel to a fiber draw direction" can be read in context of the language of claim 1, from which claim 4 ultimately depends, and which requires in step (c) "drawing optical fiber from the heated preform such that a spin is impressed on the fiber." Accordingly, the "fiber draw direction" corresponds to a direction in which the optical fiber is drawn from the heated preform. Support for that interpretation also appears at, for example, Hart 047 Patent, Col. 4, ll. 23-26 and Col. 4, line 67-Col. 5, line 3.

Importing into the claim a portion of FIG. 4, or a portion of that figure annotated by one of the parties in these proceedings is not warranted. Johnson Worldwide, 175 F.3d at 989-90.

In view of the foregoing, the term "oscillate about an axis that is substantially parallel to a fiber draw direction" is interpreted to mean as follows:

**"Oscillate about an axis that is substantially parallel to a fiber draw direction": Causing a guide roller to move back and forth about an axis which extends in a direction that is similar to the**

**direction in which the fiber is drawn from the preform.**

**C. Hart** 881 Patent **Claim Terms**

The Hart 881 Patent contains four claims, independent claim 1 and dependent claims 2-4. Contested words and phrases appear italicized in claim 1 as follows:

1. An article comprising optical communication fiber with a spin impressed on the fiber; CHARACTERIZED IN THAT the fiber is single mode optical fiber; and ***in at least a portion of the fiber the spin impressed on the fiber is alternately clockwise and counterclockwise, with a spin repeat distance of at most 20 m.***

Hart 881 Patent, Col. 6, ll. 22-27(emphasis supplied).

**D. Hart** 881 Patent **Recommended Claim Term Interpretation**

**1. "In at least a portion of the fiber the spin impressed on the fiber is alternately clockwise and counterclockwise, with a spin repeat distance of at most 20 m"**

Furukawa proposes that this term should be construed to mean:

At least one portion of the fiber having at least one clockwise spun portion changing into a counterclockwise spun portion where the change is made in 20 meters or less.

Furukawa Opening Brief, p. 47.

The Sterlite Parties propose the following interpretation for the portion of the language that reads: "spin impressed on the fiber is alternately clockwise and counterclockwise":

To satisfy this limitation, fiber must include clockwise and counterclockwise turns occurring in succession, the turns being transmitted to the fiber as it is drawn from the draw tower.

Sterlite Opening Brief on Hart Patents, p. 13. The Sterlite Parties take the position that the portion of the claim term which reads "with a spin repeat distance" is indefinite, thereby rendering all claims of the Hart 881 Patent invalid under 35 U.S.C. s. 112(2). Sterlite Opening Brief on Hart Patents, pp. 14-20.

**a. "alternately clockwise and counterclockwise"**

Furukawa's position requires only one change from clockwise to counterclockwise in order to comply with the "alternately clockwise and counterclockwise" requirement, while the Sterlite parties contend that clockwise and counterclockwise turns occur in succession. Furukawa Opening Brief, p. 47; Sterlite Opening Brief on Hart Patents, pp. 13-14.

The Hart 881 Patent specification introduces the notion of "alternately clockwise and counterclockwise" by mentioning in the Abstract that spin is impressed on the fiber that "does not have constant spatial frequency, e.g., has alternately clockwise and counterclockwise helicity." Hart 881 Patent, Abstract, ll. 9-11.

Column 3 of the Hart 881 Patent states in relevant part as follows:

[I]t is clear that a constant pitch spin will typically not result in efficient mode coupling. On the other hand, non-constant pitch spin, especially spin that has alternately positive and negative helicity, is likely to contain spatial components that produce efficient coupling. We currently believe that strong coupling can be obtained with spin of varying spatial frequency that comprises, in addition to regions of relatively high spin spatial frequency, regions of relatively low spin spatial frequency. This is, for instance, the case if the spin ***alternates between positive and negative helicity.***

Hart 881 Patent, Col. 3, ll. 25-36 (emphasis supplied). However, sinusoidal spin patterns which alternate between clockwise and counterclockwise as disclosed using the guide rollers of FIG. 4 and as shown in FIG. 6, are special or exemplary cases of where alternately clockwise and counterclockwise torque and spins are imposed on the fiber. Hart 881 Patent, Col. 5, ll. 1-4.

There is no disclosure pointed to by either of the parties that precludes portions of the fiber with no spin pitch, constant spin pitch or other spin pitch from being interposed between the spins in the first direction and the spins in the second direction, or that the number of spins in the second direction and the number of spins in the first direction are the same. *See, e.g.,* Col. 5, ll. 1-28 (referring to FIGS. 4 and 5 as examples, but not exclusive, of how spin can be impressed alternately clockwise and counterclockwise on portions of the fiber).

It is clear that the sinusoidal spatial frequency patterns shown in the plot of FIG. 6 are a special case of exemplary experimental data, and that there may be other types of alternating clockwise and counterclockwise spins. *See, e. g.,* Col. 6, ll. 10-15. ("These value are exemplary only, and those skilled in the art will, aided by teachings herein, be able to not only adapt their draw apparatus to practice the invention but also to select draw parameters that are suitable for their particular apparatus.") However, regarding spin patterns where the spin changes direction, the specification does not disclose any spin pattern, or method for impressing it on the fiber, where the spins are not impressed in a first direction, then in a second direction, and then return to the first direction along the length of the fiber (whether or not other lengths of fiber with no spin, constant spin, or other spin are interposed between the first and second directions of spin). Nor have the parties pointed to any such disclosure.

**b. "spin repeat distance"**

With respect to the term "spin repeat distance of at most 20 m," the specification refers to "spin repeat distance" as associated with a frozen-in spin, which may be "a pitch." Id. at Col. 2, ll. 54-56. Portions of the prosecution history of the Hart 881 Patent characterize and define the spin repeat distance as supported by the specification, as a function of draw speed and guide roller oscillation:

Basis for the former limitation can be found at p. 4, line 24 [Hart 881 Patent, Col. 4, ll. 2-3] which discloses that the draw speed can be as high as 20 m/sec, and at p. 6, lines 16-17 [Hart 881 Patent, Col. 5, line 33], which discloses that the guide roller oscillates back and forth at 60 cycles/min. These two parameters define the longest spin repeat distance disclosed by the specification, namely 20 m. Other spin repeat distances disclosed by the specification are 13.2 m. (20 m/sec, 106 cycles/min at p. 6, lines 18-19) [Hart 881 Patent, Col. 5, ll. 35-36]; 1.7 m (3 m/sec, 106 cycles/min; at p. 6, lines 18-19) ( Id ); and 1.5 m (1.5 m/sec, 90 [ *sic,* 60] cycles/min; at p. 6, lines 16-17) [Hart 881 Patent, Col. 5, ll. 32-33].

"Preliminary Amendment to Continuation Application Under 37 CFR 1 .62" filed in the Hart 881 Patente

prosecution history on Oct. 3, 1994, Furukawa Opening Brief, Exhibit 16, p. 2.

This language continues:

The "spin repeat distance" is graphically defined by FIG. 6. It is the distance between, for instance, consecutive peaks (or valleys) in the curve of spin spatial frequency vs. distance along the fiber.

Id.

The fourth example cited in this language, a spin repeat distance of 1.5 m produced by a draw speed of 1.5 m/sec and guide roller oscillation of 90 cycles/min (Hart 881 Patent, Col. 5, ll. 32-33) corresponds to the curve marked with numeral 60 on FIG. 6 of the Hart 881 Patent. As shown in that drawing, that distance of 1.7 m is the distance between successive peaks on curve 60, or the distance between the first point on the curve and the second point on the curve where the spin pattern along the fiber begins to repeat itself.

This discussion in the prosecution history of support for the term "spin repeat distance" is not inconsistent with the language at Hart 881 Patent, Col. 2, ll. 54-56, which can be understood to recognize that "a pitch" and "the spin repeat distance" may be associated with "a frozen-in spin", but not necessarily to mean that "spin repeat distance" is the same as a particular pitch such as, for instance, the pitch of the spin.

The Sterlite Parties propose that the language "spin repeat distance" is indefinite under 35 U.S.C. s. 112 because the language at Col. 2, ll. 54-56 of the specification and the language in the prosecution history which discusses support for that term in the claim are irreconcilable. Sterlite Parties Opening Brief on Hart Patents, pp. 14-18. Therefore, Sterlite Parties propose that the four Hart 881 Patent claims, which all include this language, should not be interpreted in these proceedings but rather held invalid as indefinite under 35 U.S.C. s. 112. This argument is not consistent with Federal Circuit precedent. Exxon Research & Eng'g Co. v. United States, 265 F.3d 1371, 1375 (Fed.Cir.2001). The Federal Circuit there indicated that claims should be held indefinite only after the Court has made a reasonable attempt to construe the claim and the attempt had proved futile. *Id*. This process is necessary to respect the presumption of patent validity. *Id*. In this case, the meaning of "spin repeat distance" is subject to proper interpretation using the Hart 881 Patent specification and prosecution history as above. Accordingly, the Special Master recommends to the Court that the meaning of "spin repeat distance" should not found indefinite, nor should any claims 1-4 of the Hart 881 Patent be found invalid under 35 U.S.C. s. 112, but rather that this claim term should be interpreted as recommended below, as part of the interpretation of the entire claim term "in at least a portion of the fiber, spin impressed on the fiber is alternately clockwise and counterclockwise with a spin repeat distance of at most 20 m."

In view of the foregoing, this term is interpreted as follows:

**"In at least a portion of the fiber, spin impressed on the fiber is alternately clockwise and counterclockwise with a spin repeat distance of at most 20 m": A repeating pattern of spins along the fiber, including at least one first segment along the fiber having a number of spins in a first, such as clockwise or counterclockwise direction, each first segment followed by a second segment along the fiber having a number of spins in the opposite, such as counterclockwise or clockwise direction from its preceding first segment. At least a portion of the fiber has a spin repeat distance, which is the distance between a point on the fiber at which such a pattern of spins starts, and a corresponding point at which the pattern of spins begins to repeat, that is not greater than 20 meters. As nonlimiting**

**examples, the spin repeat distances of curves 60 and 61 of Fig. 6 of the Hart** 881 Patent **are approximately 1.7 meters and 1.5 meters, respectively.**

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