

Description

The present invention relates to optical fibers. More particularly, it relates to a method for manufacturing a single-mode optical fiber in which the core is formed of laminae, adjacent ones of which have different refractive indices.

In certain applications of single-mode optical waveguide fibers, e.g. gyroscopes, sensors and the like, it is important that the propagating optical signal retain the polarization characteristics of the input light in the presence of external depolarizing perturbations. This requires the fiber to have an azimuthal asymmetry of the refractive index profile. European Patent No. 128.024 entitled "Polarization Retaining Single-Mode Optical Waveguide" filed in the name of Corning Glass Works on June 1, 1984 and published on 12.12.1984. (The document falling under art. 54(3) is not relevant to the question of inventive step) describes a fiber, the core of which is formed of a plurality of laminae of transparent material, adjacent ones of which have different refractive indices. It would be advantageous to form the core of such a fiber by a chemical vapor deposition (CVD) technique so that the fiber is suitable for transmitting optical signals over long distances.

Methods of forming optical fibers having an azimuthal asymmetry of the refractive index profile are disclosed in US-A-3,980,459 (Li) and US-A-3,982,916 (Miller) and in US-A-4,528,009, "Method of Forming Optical Fiber having Laminate Core" (A. Sarkar) filed June 1, 1983 and published on 09.07.1985. One or more layers are formed on the inner surface of a substrate tube by flowing a reactant vapor through the tube and heating the tube and contained vapor mixture with a moving heat source, external to the substrate tube, such that a suspension of glass particles is produced within the substrate tube, the particles traveling downstream and being fused to form a continuous glassy deposit on the inner surface. An asymmetric structure is formed in inserting a rod into the substrate tube or by asymmetrically heating the substrate tube to preferentially deposit glass particles on a specific region of the tube.

Methods of forming optical fibers having azimuthal asymmetry is also disclosed in DE-A-2,930,791 (Licentia). One of the disclosed methods comprises the steps of providing an elongated mandrel having a rectangular cross-section, said mandrel including first and second opposed, longitudinally extending planar sidewalls and two remaining sidewalls of smaller area than said first and second sidewalls, forming a core on said mandrel, forming a cladding on said core, and forming an optical fiber from the resultant preform.

It is an object of the present invention to provide a method forming an optical fiber preform having an azimuthally asymmetric core region. Another object is to provide a method of making such fibers which is not subject to excessive loss due to breakage.

According to the present invention there is provided a method of forming an optical fiber comprising the steps of providing an elongated mandrel having a rectangular cross-section, said mandrel including first and second opposed, longitudinally extending planar sidewalls and two remaining sidewalls of smaller area than said first and second sidewalls, forming a core on said mandrel, forming a cladding on said core, and forming an optical fiber from the resultant preform, said method being characterized in that the step of forming a core comprises providing a stream of glass particles, longitudinally translating said first sidewall with respect to said stream to form at least two planar layers of glass particles thereon, longitudinally translating said second sidewall with respect to said stream to form at least two planar layers of glass particles thereon, adjacent ones of said planar layers having different refractive indices, the step of longitudinally translating said mandrel with respect to said stream to form said planar layers on said first and second sidewalls also resulting in the formation of further soot layers on said two remaining sidewalls, said further soot layers being thinner than said planar layers, and consolidating said layers of glass particles to form a core structure having a plurality of parallel dense glass laminae.

In the accompanying drawings:

Figures 1 and 2 illustrate the application of successive coatings of glass soot to a mandrel,

Figure 3 is a cross-sectional view of a porous core structure,

Figure 4 illustrates the application of cladding soot to a consolidated core structure,

Figures 5 and 6 are cross-sectional views of modified core structures.

It is to be noted that the drawings are illustrative and symbolic of the present invention and there is no intention to indicate the scale or relative proportions of the elements shown therein.

It is well known that single-mode optical fibers can be fabricated by first forming the core portion thereof as a separate structure and thereafter applying to the core structure a layer of cladding glass and drawing the composite body to form an optical fiber.

U.S. Patent No. 4,360,371, for example, teaches that an initially fabricated core structure can be rotated about its longitudinal axis while a layer of cladding glass particles is deposited thereon by a flame hydrolysis burner which is longitudinally translated with respect to the rotating core structure. The resultant structure can be drawn into an optical fiber, or it can be heated to a temperature sufficient to consolidate the porous portion thereof and thereafter drawn into an optical fiber. A core structure can also be inserted into a hollow glass cylinder and the resultant composite structure heated and drawn into an optical fiber as taught in U.S. Patent No. 3,932,162.

In accordance with the present invention a core structure comprising a laminated core is formed in accordance with the method illustrated in

Figures 1, 2, and 3. Elongated mandrel 10 of flattened cross-sectional configuration has first and second opposed planar surfaces 12 and 14. In a first embodiment hereof wherein mandrel 10 forms a part of the resultant optical fiber, the mandrel must be formed of extremely pure glass and is therefore preferably formed by a CVD process. For example, glass particles formed by the flame hydrolysis process can be collected and cast into the desired shape in accordance with the process disclosed in European Published Application No. 0084438 published 27 July 1983. Mandrel 10 could also be made by directing soot from a flame hydrolysis burner onto a substrate to build up a coating of sufficient thickness, consolidating the soot to a dense glass and severing suitably shaped strips from the dense glass body by sawing, grinding or the like. The resultant strips can be ground and polished to the final desired shape. After such mechanical operations as sawing and grinding, the surface of the resultant mandrel should be cleaned by subjecting it to an etchant such as HF, rinsing and drying.

A stream 16 of glass soot is directed toward surface 12 of mandrel 10 from soot deposition means 18 which can comprise any soot deposition burner or burners including flat-faced burners, ribbon burners, or the like, which provide a stream of particulate material. For an illustration of suitable burners, reference is made to U.S. Patents Nos. 3,565,345 and 4,165,223. Means 16 may also comprise nozzles such as those disclosed in U.S. Patent No. 3,957,474 which emit reactant vapors which are heated by means such as a laser beam to form a soot stream. Since a soot deposition burner is preferred, reference will hereinafter be made to that particular type of deposition means.

While maintaining mandrel 10 rotationally stationary, it is translated longitudinally one or more times with respect to burner 18 as indicated by arrow 22 to deposit a soot coating 20 on surface 12. Reference herein to translating mandrel 10 with respect to stream 16 includes translating the stream 16 with respect to a stationary mandrel or any combination of movement by mandrel 10 and stream 16 which results in the deposition of coating 20. Mandrel 10 is then rotated 180°, and thereafter translated with respect to burner 18 one or more time to deposit soot coating 24 on surface 14 thereof. The composition of soot coatings 20 and 24 is such that the refractive index thereof is different from that of mandrel 10 in the present embodiment wherein the mandrel remains as part of the resultant optical fiber. The composition of soot stream 16 is then changed and two additional soot coatings 26 and 28 are deposited in the manner described above upon the surfaces of coatings 24 and 20, respectively. In like manner, the composition of soot stream 16 is again changed and soot coatings 30 and 32 are deposited on the surfaces of coatings 28 and 26, respectively. In accordance with the teachings of the aforementioned Application No: 84303695.5 it

is only necessary that adjacent soot coatings have different refractive indices. In a particular embodiment, coatings 26 and 28 have the same refractive index as mandrel 10 and coatings 20, 24, 30 and 32 all have the same refractive index which is different from that of mandrel 10.

After the desired number of coatings is applied to mandrel 10, the resultant porous preform can be consolidated to form an elongated core structure. It is sometimes preferred to add a thin layer of cladding material to this core structure. Figure 3 shows a coating 36 of cladding soot which has been deposited over the outer coatings 30 and 32 of core soot. As disclosed in U.S. Patent No. 4,360,371, strips of cladding glass soot can be deposited over the flattened sidewalls of the laminated core soot structure prior to rotating the core soot structure and depositing coating 36 of cladding soot. This accelerates the formation of a circular outer cladding surface. However, the steps of depositing such strips of cladding glass soot may be omitted without affecting to too great of an extent the geometry of the resultant fiber. If cladding soot 36 is deposited directly upon layers 30 and 32 of core soot, the soot stream from the burner will deposit a greater amount soot when the flattened portions of the core soot structure are facing the burner than when the rounded or corner portions thereof are facing the burner since soot collection efficiency is a function of target size. This tends to decrease the noncircularity of the deposited structure as coating 36 is built up.

The soot structure shown in Figure 3 is consolidated to form elongated core structure 40 which is shown in cross-section in Figure 4. After the consolidation process, the dense glass core structure is heated and stretched until the average cross-sectional dimension thereof is small enough that it can function as a mandrel upon which the outer cladding glass can be deposited. It is preferred that the average cross-sectional dimension of this dense glass core structure be within the range of about 4 to 10 mm. It is then severed into a plurality of rods of suitable lengths for mounting in a glass lathe. Core structure 40 is then rotated as indicated by arrow 42 and is translated with respect to soot stream 16 while outer coating 44 of cladding soot is built up. Substantial circularity should be achieved when the outside diameter of coating 44 is sufficient, relative to the size of the core, to enable the resultant fiber to function as a single-mode fiber.

The resultant structure can be consolidated and thereafter drawn into an optical fiber. Consolidation is preferably carried out in the presence of a halogen such as chlorine which dries the soot as it sinters.

The resultant fiber is a single polarization single-mode optical waveguide of the type taught in the aforementioned European Patent No: 128,024. Such a fiber functions to retain input polarization only if the core laminae have a thickness less than the wavelength λ of the light propagating therethrough. Such a thickness can

be achieved by controlling the thicknesses of the deposited soot layers and by drawing or elongating those layers a sufficient amount from the time the soot is deposited until the final fiber is formed. For example, a core preform having a diameter greater than 10 mm can be heated and stretched into a rod or intermediate fiber having a diameter of about 4 to 10 mm prior to adding the cladding soot. The cladding soot is then deposited to a sufficient thickness to ensure that the thickness of each lamina in the resultant optical fiber is less than λ . The steps of overcladding and drawing can be performed any number of times as required to obtain the desired laminae thickness.

Referring to Figure 2, it is noted that during the application of coating 20 to surface 12, a portion of the applied soot deposits on the curved portions of mandrel 10. Thus, as shown in Figure 3, in addition to the desired planar coatings, thin regions of glass soot are built up along both of the narrow curved regions of the mandrel. The combined thickness of these thin regions of core glass is illustrated in Figure 4 as being d_0 . If the distance d_0 is significantly smaller than the distance between the surfaces of the outer core lamina, the core structure will adequately approximate the design proposed in the aforementioned European Patent No: 128.024, and therefore result in a single polarization, single-mode optical fiber.

That portion of the core structure which would result in the edge portions of the core within the thickness d_0 may be removed prior to depositing cladding soot 36. After the outer soot layers 30 and 32 are deposited, the resultant structure is consolidated, and the undesired portions thereof can be removed by sawing, grinding or the like. The resultant structure, which is illustrated in Figure 5, can then be coated with cladding soot and formed into an optical fiber as described above. Prior to the application of cladding soot, the surfaces of the structure of Figure 5 should be etched, rinsed and dried.

An alternative treatment for the core structure results in the structure illustrated in Figure 6. The consolidated core structure can be rotated about its longitudinal axis in the an abrasive slurry to round the corners. Depending upon the length of time that this treatment is preformed, a structure having any shape between that shown in Figure 5 and that shown in Figure 6 can be obtained.

As an alternative to the embodiment wherein the mandrel remains as part of the resultant optical fiber, mandrel 10 of Figure 3 could be removed from the soot preform prior to the time that consolidation occurs. In this embodiment, only one of the soot layers 20 and 24 need be deposited to form the central lamina. Alternatively, the thicknesses of layers 20 and 24 can be made to be one-half of the desired thickness of the central lamina. Upon consolidation, these two thin layers combined to form the central lamina. If the mandrel is removed from the soot preform, the resultant aperture may close during the consolidation process depending upon such conditions as the viscosity of the innermost layers

during the consolidation process as compared with the viscosity of the cladding glass. Also, a low pressure applied to the aperture during the consolidation process or during the process of stretching the consolidated preform into an elongated rod suitable for deposition of cladding glass, can assist aperture closing. A discussion of conditions which enhance the closing of the mandrel aperture can be found in U.S. Patent No. 4,251,251.

Rather than depositing layers of soot, alternate ones of which have different refractive indices, it may be possible to take advantage of the variation in composition and in refractive index which naturally occurs during the deposition of a layered soot structure. As taught in the publications N. Yoshioka et al. "Graded Index Profile Formation and Transmission Characteristics of VAD Fiber", Paper No. 2, 6th ECOR, York, United Kingdom, 1980, pp 10-13 and Okamoto et al. Applied Optics, Vol. 20, No. 13, 1 July 1981, pp 2314-2318, the concentration of a dopant oxide such as GeO_2 in a deposited soot layer depends, inter alia, upon the temperature of the substrate. As the soot stream from a flame hydrolysis burner advances along a substrate, the temperature of the substrate at the trailing portion of the soot stream is hotter than the temperature of the leading portion thereof. This temperature variation produces compositional variations within each layer of deposited soot. The result of such compositional variations within a single soot layer is the formation of a structure having alternate layers of high and low refractive index. Thus, a single composition soot stream may be used to deposit all of the soot coatings. The compositional variation required for the existence of laminae, adjacent ones of which have different refractive indices, is obtained by the naturally occurring compositional variation within each coating. If this effect does not result in a great enough difference in refractive index between the high index and the low index regions of a deposited layer, a core formed by this technique can be employed in a fiber having additional polarization retaining characteristics such as stress rods at diametrically opposed sides of the core, an elliptically-shaped inner cladding surrounded by an outer stress cladding, or the like.

Claims

1. A method of forming an optical fiber comprising the steps of providing an elongated mandrel (10) having a rectangular cross-section, said mandrel including first and second opposed, longitudinally extending planar sidewalls (12, 14) and two remaining sidewalls of smaller area than said first and second sidewalls, forming a core on said mandrel (10), forming a cladding (36, 44) on said core, and forming an optical fiber from the resultant preform, said method being characterized in that the step of forming a core comprises providing a stream (16) of glass particles,

be achieved by controlling the thicknesses of the deposited soot layers and by drawing or elongating those layers a sufficient amount from the time the soot is deposited until the final fiber is formed. For example, a core preform having a diameter greater than 10 mm can be heated and stretched into a rod or intermediate fiber having a diameter of about 4 to 10 mm prior to adding the cladding soot. The cladding soot is then deposited to a sufficient thickness to ensure that the thickness of each lamina in the resultant optical fiber is less than λ . The steps of overcladding and drawing can be performed any number of times as required to obtain the desired laminae thickness.

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during the consolidation process as compared with the viscosity of the cladding glass. Also, a low pressure applied to the aperture during the consolidation process or during the process of stretching the consolidated preform into an elongated rod suitable for deposition of cladding glass, can assist aperture closing. A discussion of conditions which enhance the closing of the mandrel aperture can be found in U.S. Patent No. 4,251,251.

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Claims

1. A method of forming an optical fiber comprising the steps of providing an elongated mandrel (10) having a rectangular cross-section, said mandrel including first and second opposed, longitudinally extending planar sidewalls (12, 14) and two remaining sidewalls of smaller area than said first and second sidewalls, forming a core on said mandrel (10), forming a cladding (36, 44) on said core, and forming an optical fiber from the resultant preform, said method being characterized in that the step of forming a core comprises providing a stream (16) of glass particles,





longitudinally translating said first sidewall (12) with respect to said stream to form at least two planar layers (20, 28) of glass particles thereon, longitudinally translating said second sidewall (14) with respect to said stream to form at least two planar layers (24, 26) of glass particles thereon, adjacent ones of said planar layers having different refractive indices, the step of longitudinally translating said mandrel (10) with respect to said stream (16) to form said planar layers on said first and second sidewalls also resulting in the formation of further soot layers on said two remaining sidewalls, said further soot layers being thinner than said planar layers, and consolidating said layers of glass particles to form a core structure having a plurality of parallel dense glass laminae.

2. A method in accordance with claim 1 further comprising the step of applying to said plurality of layers of glass particles a layer of preliminary cladding glass particles prior to said consolidation step.

3. A method in accordance with claim 2 further comprising the steps of removing said mandrel (10) from the composite of said plurality of layers of glass particles and said layer of preliminary cladding particles prior to said consolidation step.

4. A method in accordance with claim 1 further comprising the step of removing said further soot layers and removing a portion of said planar layers (20, 28) on said first and second sidewalls (12, 14) after consolidation thereof to form a core wherein the surfaces thereof perpendicular to said planar layers (20, 28) is flat.

5. A method in accordance with claim 1 further comprising the step of removing said further soot layers and removing a portion of said planar layers (20, 28) on said first and second sidewalls (12, 14) after consolidation thereof to form a core wherein the surfaces perpendicular to said planar layers is rounded.

6. A method in accordance with any preceding claim wherein the step of depositing comprises maintaining said mandrel (10) rotationally stationary, directing a stream (16) of glass particles toward said mandrel (10), providing relative translational motion between said mandrel (10) and said stream (16) to form on said first flat surface 12 thereof a coating of glass particles, rotating said mandrel (10) 180°, providing relative translational motion between said mandrel (10) and said stream (16) to form on said second flat surface (14) thereof a coating of glass particles, changing the composition of said stream (16) of glass particles and applying additional coatings of glass particles to the previously applied coatings, the composition of said additional coatings being such that the refractive indices of adjacent coatings are dissimilar.

7. A method in accordance with claim 1 wherein the step of forming a cladding (36, 44) comprises rotating said core about its longitudinal axis and depositing thereon a coating of cladding soot.

8. A method in accordance with claim 7 wherein prior to the step of depositing cladding soot, said core is stretched to reduce the diameter thereof.

Patentansprüche

1. Verfahren zur Herstellung einer optischen Faser, bestehend aus den Verfahrensschritten, daß ein langgestreckter Dorn (10) mit einem rechtwinkligen Querschnitt geschaffen wird, wobei der Dorn eine erste und eine zweite gegenüberliegende sich in Längsrichtung erstreckende ebene Seitenwand (12, 14) und zwei restliche Seitenwände mit kleinerer Fläche als die erste und zweite Seitenwand aufweist,

daß ein Kern auf dem Dorn (10) geformt wird, daß eine Ummantelung (36, 44) auf dem Kern gebildet wird und

daß aus dem resultierenden Rohling eine optische Faser geformt wird, dadurch gekennzeichnet,

daß der Schritt der Bildung eines Kerns besteht aus dem Vorsehen eines Stroms (16) aus Glaspartikeln,

dem Verschieben der ersten Seitenwand (12) bezüglich des Stroms in Längsrichtung, um darauf wenigstens zwei ebene Schichten (20, 28) aus Glaspartikeln zu bilden,

dem Verschieben der zweiten Seitenwand (14) bezüglich des Stroms in Längsrichtung, um darauf wenigstens zwei ebene Schichten (24, 26) aus Glaspartikeln zu bilden, wobei zueinander benachbarte ebene Schichten unterschiedliche Brechungsindizes haben, wobei der Verfahrensschritt des Verschiebens des Dorns (10) bezüglich des Stroms (16) in Längsrichtung zur Bildung der ebenen Schichten auf der ersten und der zweiten Seitenwand auch zu der Bildung von weiteren Rußschichten auf den beiden übrigen Seitenwänden führt, wobei die weiteren Rußschichten dünner sind als die ebenen Schichten, und wobei die Schichten aus Glaspartikeln konsolidiert werden, um einen Kernaufbau zu bilden, der eine Vielzahl von parallelen dichten dünnen Glasschichten zu bilden.

2. Verfahren nach Anspruch 1, weiterhin gekennzeichnet durch den Verfahrensschritt, daß auf die Vielzahl von Schichten aus Glaspartikeln vor dem Konsolidierungsschritt eine Schicht aus vorbereiteten Mantelglaspartikeln aufgebracht wird.

3. Verfahren nach Anspruch 2, weiterhin gekennzeichnet durch die Verfahrensschritte, daß der Dorn (10) aus der Zusammensetzung aus der Vielzahl von Schichten aus Glaspartikeln und der Schicht aus vorläufigen Mantelpartikeln vor dem Konsolidierungsschritt entfernt wird.

4. Verfahren nach Anspruch 1, weiterhin gekennzeichnet durch den Verfahrensschritt, daß die weiteren Rußschichten entfernt werden und daß ein Abschnitt der ebenen Schichten (20, 28) auf der ersten und der zweiten Seitenwand (12, 14) nach deren Konsolidierung entfernt wird, um einen Kern zu bilden, wobei deren Oberflächen senkrecht zu den ebenen Schichten (20, 28) flach sind.

5. Verfahren nach Anspruch 1, weiterhin gekennzeichnet durch den Verfahrensschritt, daß die weiteren Rußschichten entfernt werden und daß ein Abschnitt der ebenen Schichten (20, 28) auf der ersten und der zweiten Seitenwand (12, 14) nach



deren Konsolidierung entfernt wird, um einen Kern zu bilden, wobei die Oberflächen senkrecht zu den ebenen Schichten gerundet wird.

6. Verfahren nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß der Verfahrensschritt des Niederschlagens daraus besteht, daß der Dorn (10) drehbar stationär beibehalten wird, daß ein Strom (16) aus Glaspartikeln auf den Dorn (10) gerichtet wird, daß eine relative Verschiebewegung zwischen dem Dorn (10) und dem Strom (16) vorgesehen wird, um auf seiner ersten flachen Oberfläche (12) eine Beschichtung aus Glaspartikeln zu bilden, daß der Dorn (10) um 180° gedreht wird, daß eine relative Verschiebewegung zwischen dem Dorn (10) und dem Strom (16) vorgesehen wird, um auf seiner zweiten flachen Oberfläche (14) eine Beschichtung aus Glaspartikeln vorzusehen, daß die Zusammensetzung des Strom (16) aus Glaspartikeln geändert wird und daß zusätzliche Beschichtungen aus Glaspartikeln auf die zuvor aufgetragenen Beschichtungen aufgebracht werden, wobei die Zusammensetzung der zusätzlichen Schichten derart ist, daß die Brechungsindizes benachbarter Beschichtungen verschieden sind.

7. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Verfahrensschritt zur Bildung eines Mantels (36, 44) das Drehen des Kerns um seine Längsachse und das Niederschlagen einer Beschichtung aus Mantelruß auf diesem umfaßt.

8. Verfahren nach Anspruch 7, dadurch gekennzeichnet, daß vor dem Verfahrensschritt des Niederschlagens von Mantelruß der Kern zur Verringerung seines Durchmessers gereckt wird.

Revendications

1. Un procédé de formation d'une fibre optique comprenant les étapes qui consistent à fournir un mandrin allongé (10) de section transversale rectangulaire, ledit mandrin comprenant des première et seconde parois latérales opposées planes (12, 14) s'étendant longitudinalement et deux parois latérales restantes de plus petite surface que lesdites première et seconde parois latérales, à former un coeur sur ledit mandrin (10), à former une gaine (36, 44) sur ledit coeur, et à former une fibre optique à partir de la préforme résultante, ledit procédé étant caractérisé en ce que l'étape de formation d'un coeur consiste à fournir un courant (16) de particules de verre, à déplacer en translation longitudinale ladite première paroi latérale (12) par rapport audit courant afin d'y former au moins deux couches planes (20, 28) de particules de verre, à déplacer en translation longitudinale ladite seconde paroi latérale (14) par rapport audit courant afin d'y former au moins deux couches planes (24, 26) de particules de verre, celles desdites couches planes qui sont adjacentes ayant des indices de réfraction différents, l'étape consistant à déplacer en translation longitudinale ledit mandrin (10) par rapport audit courant (16) afin de former lesdites couches planes sur lesdites première et seconde parois latérales aboutissant également à la forma-

tion de couches de suie de verre supplémentaires sur les deux dites parois latérales restantes, ces couches de suie de verre supplémentaires étant plus minces que lesdites couches planes, et à consolider lesdites couches de particules de verre pour former une structure de coeur comportant une pluralité de strates parallèles de verre dense.

2. Un procédé selon la revendication 1 comprenant de plus l'étape consistant à appliquer auxdites plusieurs couches de particules de verre une couche de particules de verre de gainage préliminaire avant ladite étape de consolidation.

3. Un procédé selon la revendication 2 comprenant de plus les étapes consistant à retirer ledit mandrin (10) du composite constitué de ladite pluralité de couches de particules de verre et de ladite couche de particules de gainage préliminaire avant ladite étape de consolidation.

4. Un procédé selon la revendication 1 comprenant de plus l'étape consistant à éliminer lesdites couches de suie de verre supplémentaires et à éliminer une partie desdites couches planes (20, 28) présentes sur lesdites première et seconde parois latérales (12, 14) après leur consolidation afin de former un coeur dans lequel les surfaces de celui-ci perpendiculaires auxdites couches planes (20, 28) sont plates.

5. Un procédé selon la revendication 1 comprenant de plus l'étape consistant à éliminer lesdites couches de suie de verre supplémentaires et à éliminer une partie desdites couches planes (20, 28) présentes sur lesdites première et seconde parois latérales (12, 14) après leur consolidation afin de former un coeur dans lequel les surfaces perpendiculaires auxdites couches planes sont arrondies.

6. Un procédé selon l'une quelconque des revendications précédentes dans lequel l'étape de dépôt consiste à maintenir ledit mandrin (10) fixe pour la rotation, à diriger un courant (16) de particules de verre vers ledit mandrin (10), à établir un mouvement de translation relatif entre ledit mandrin (10) et ledit courant (16) afin de former sur ladite première surface plate (12) dudit mandrin (10) un revêtement de particules de verre, à faire tourner ledit mandrin (10) de 180°, à établir un mouvement de translation relatif entre ledit mandrin (10) et ledit courant (16) pour former sur ladite seconde surface plate (14) dudit mandrin (10) un revêtement de particules de verre, à modifier la composition dudit courant (16) de particules de verre et à appliquer d'autres revêtements de particules de verre sur les revêtements précédemment appliqués, la composition desdits autres revêtements étant telle que les indices de réfraction de revêtements adjacents soient différents.

7. Un procédé selon la revendication 1 dans lequel l'étape de formation d'une gaine (36, 44) consiste à faire tourner ledit coeur autour de son axe longitudinal et à y déposer un revêtement de suie de verre de gainage.

8. Un procédé selon la revendication 7 dans lequel, avant l'étape de dépôt de suie de verre de gainage, ledit coeur est étiré afin de réduire son diamètre.

