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(54) **HAIR TREATMENT METHOD INVOLVING IRRADIATION THROUGH AN OPTICAL MEDIUM**

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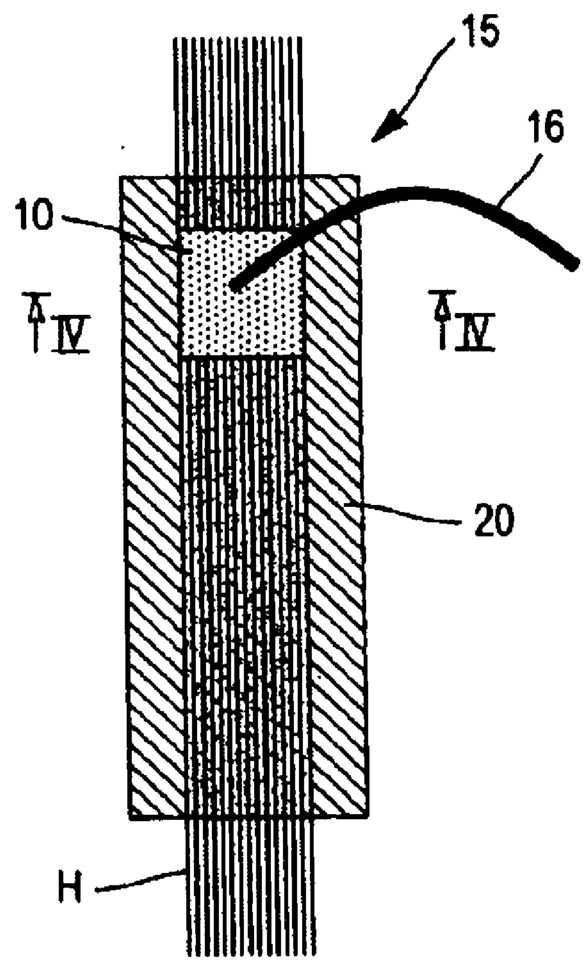
(57) **ABSTRACT**

Hair treatment method in which at least one portion of at least one hair (H) is exposed to at least one pulse of light through a fluid or solidified transparent medium (M) with a refractive index of 1.3 or higher, this medium being in contact with the hair or hairs and extending between the hair or hairs and a surface (I) at which light enters the medium, preferably of predefined form.



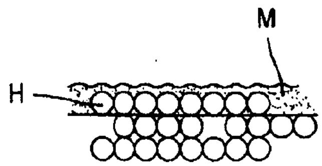


FIG. 1A

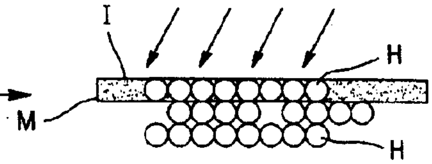


FIG. 1B

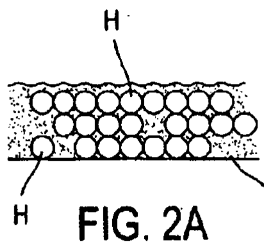


FIG. 2A

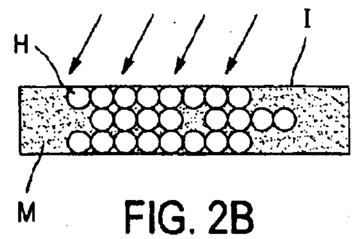


FIG. 2B

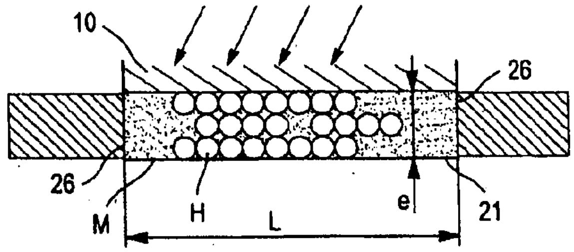


FIG. 4

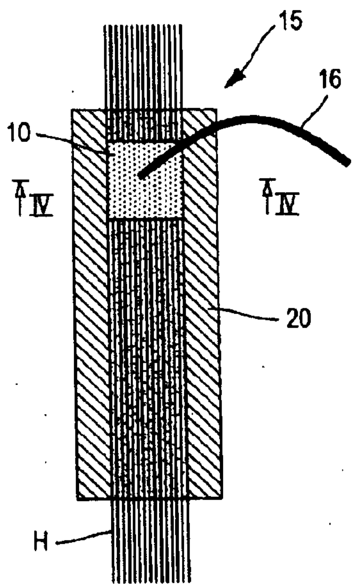


FIG. 3

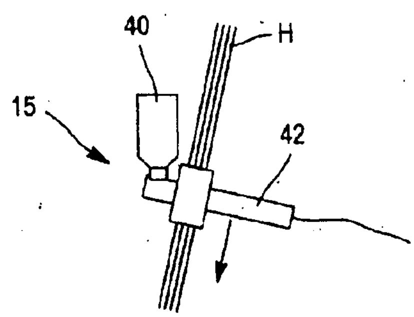


FIG. 5

HAIR TREATMENT METHOD INVOLVING IRRADIATION THROUGH AN OPTICAL MEDIUM

[0001] The present invention relates to the cosmetic treatment of human or animal keratin fibers. The invention more particularly relates to hair treatments by irradiation.

[0002] Many hair treatments use light for treating the hair, for example for more or less substantially bleaching the melanin.

[0003] Applications U.S. Pat. No. 4,792,341, U.S. Pat. No. 5,246,019, U.S. Pat. No. 5,303,722, EP 685 220 A1, EP 682 937 B1 and US 2007 10167936 A1 thus describe hair bleaching methods using irradiation devices.

[0004] U.S. Pat. No. 5,246,019 discloses the application of a bleaching composition (alcoholic or hydro-alcoholic solution, emulsion or gel) present on the hair at the time of irradiation, which irradiation preferably uses continuous light. Rinsing is then performed.

[0005] EP 685 220 teaches of subjecting wet hair to a bleaching treatment with pulsed light.

[0006] EP 682 937 teaches of cooling the treated area by circulating a fluid, for example a gas comprising water droplets.

[0007] The light must be used so as not to degrade the keratin fibers, and complying with irradiation conditions that avoid degradation of the fiber proves to be a constraint on the development of these methods.

[0008] It has been proposed to use cooling devices to avoid heating the keratin fibers. However, cooling does not prevent the fibers from being degraded under certain irradiation conditions and makes the treatment system more complex and expensive. Furthermore, cooling devices are generally not suited to firing frequencies of greater than 100 Hz.

[0009] There is a need to benefit from a method for treating hair by irradiation, which is rapid while at the same time limiting the risks of degradation of the hair, and the invention is directed toward satisfying this need.

[0010] A subject of the invention is thus, according to one of its aspects, a hair treatment method in which at least a portion of at least one hair is exposed to at least one light pulse through a transparent medium, which is fluid or which has solidified, with a refractive index advantageously of greater than or equal to 1.3 (at 20° C.) and if possible greater than 1.4, this medium being in contact with the hair and extending between the hair and a surface of the medium, via which the light enters the medium.

[0011] The presence of the transparent medium makes it possible to use light pulses with a peak power of greater than or equal to 10^5 W, for example, reducing or even eliminating the risk of degradation of the hairs at high power values. The firing frequency may be greater than or equal to 100 Hz, or even 1 kHz or 10 kHz.

[0012] The transparent medium also makes it possible to increase the quality of the result obtained. As a nonlimiting example, during bleaching, the presence of the transparent medium makes it possible to bleach the two opposite faces of a layer of hairs. Advantageously, since the quality is improved, it is possible to reduce the number of firings or the energy per firing. The risk of degrading the hairs is thus reduced. It is also possible to treat thicker locks, since the transparent medium allows the effect of the light radiations to be propagated to the lower layers of the hairs of the lock.

[0013] The transparent medium also makes it possible to reduce the odors given off.

[0014] The shape of the surface for the entry of light into the medium is advantageously of predefined shape.

[0015] The shape of this surface may be defined by a transparent wall of an irradiation device in contact with the transparent medium. This transparent wall may be part of an optical channel of the irradiation device. The transparent wall may define an optical output of this irradiation device. As a variant, the transparent wall is intermediate between an optical channel for the entry of light and the transparent medium, and protects, for example, the optical channel from the risk of soiling or wetting by the transparent medium. The transparent wall may be mobile relative to the hairs and/or mobile relative to a hair guide system.

[0016] The light entry surface may be defined by levelling or flattening the medium, prior to exposure to the light pulse. The light entry surface may or may not be in contact with the air.

[0017] The levelling or flattening of the medium may be linked to the movement of a treatment system member.

[0018] The levelling or flattening may take place manually or be performed automatically by the treatment system used.

[0019] The predefined shape may also be obtained with local fusion of the transparent medium. A meltable wax may be used. Such a wax may be introduced in powder form so as to surround the hairs. Applying heat makes the wax melt.

[0020] The transparent medium may be liquid at the time of irradiation. It may also be liquid when it comes into contact with the hairs and solidify thereafter, so that it is solid at the time of irradiation. The light entry surface may have its shape defined while the medium is still liquid. As a variant, the predefined shape of the entry surface may be obtained after the medium has become solid. The term "solid" includes a state in which the medium is gelled.

[0021] The removal of the transparent medium after irradiation may take place by suction, drying, heating, washing and/or evaporation, according to the nature of the medium.

[0022] The entire section of at least one treated hair may be included in the transparent medium at the time of irradiation. At least two and better still three layers of superposed hairs may be included in the transparent medium and exposed simultaneously to the light pulse(s). All the treated hairs may be at the back of the light entry surface. As mentioned hereinabove, the transparent medium contributes toward delivering the light to the hairs of the layers below the first layer, which makes it possible to treat several layers of hairs simultaneously.

[0023] The transparent medium may be cooled, where appropriate, for example so as to maintain a temperature of between −50 and 50° C.

[0024] The transparent medium may be static relative to the hairs during the irradiation, or may circulate. Circulation of the transparent medium is directed, for example, toward improving the conduction of heat and avoiding the creation of hot spots.

[0025] The treated hair(s) may be confined within a guide system defining the treatment space containing the hairs and the transparent medium. The treatment space may be of constant or adjustable dimensions, for example so as to adapt it to the size of a lock to be treated.

[0026] The hairs may, where appropriate, be packed into the treatment space.

[0027] During the treatment, the hairs may be immobile in the treatment space. As a variant, the treatment space is moved along the hairs during the irradiation. The movement of the treatment space is caused, for example, by moving a transparent wall relative to a hair guide system, this wall coming into contact with the transparent medium and imposing its shape on the light entry surface in the transparent medium. The transparent wall may be part of an optical channel, for example one or more optical fibers, or may be interposed between the optical channel and the transparent medium. Means may be provided, where appropriate, for containing the transparent medium in the treatment space despite the movement of the hairs. The treatment space is, for example, delimited by medium-confining components comprising, for example, elastically deformable joints that are applied against the hairs. The treatment space may also be continuously fed with transparent medium, so as to ensure that a sufficient amount of transparent medium coats the hairs that are to be irradiated, taking into account the losses associated with the non-leaktightness of the treatment space.

[0028] The treatment of the hairs may be performed over a basin for recovering the transparent medium. Depending on the nature of the transparent medium, the recovered medium may be evacuated to the wastewater, for example if it is pure water or water containing an additive that is not to be recycled, or that is to be at least partially recycled, after an optional filtration.

[0029] A composition whose role is twofold, for example making it possible to benefit from a high refractive index and to exert another action on the hairs, may be used to prepare the transparent medium. For example, glycerol may be used, which will give the hair an emollient effect.

[0030] The transparent medium may be dispensed over the hair from at least one orifice for delivering said transparent medium, this orifice being able to be moved relative to the hairs between two light pulses. Delivery of the fluid intended to form the transparent medium may take place via a delivery orifice that occupies a variable position relative to a hair guide system.

[0031] The light treatment may be directed toward bleaching the hairs and/or giving them remanent reshaping, which is different than a hair-removal treatment. During the implementation of the process, it is possible for the light not to reach the scalp or the skin.

[0032] A subject of the invention is also, according to another of its aspects, a treatment system comprising:

- [0033] an irradiation device comprising a source of pulsed light,
- [0034] a source of a fluid or solidifiable transparent medium, with a refractive index of greater than or equal to 1.3,
- [0035] a system for guiding the hairs to be treated, configured so as to receive the hairs to be treated, the treatment system being configured to bring the transparent medium into contact with the hairs and preferably arranged to give a predefined shape to a surface for the entry of light into the medium.

[0036] The treatment system may comprise a source of fluid used for forming the transparent medium, for example a reservoir containing said fluid, or a pipe connecting to a source of said fluid or of a component of the medium, for example a pipe for connecting to a water source and one or more optional reservoirs of one or more additives to be mixed with water to form the transparent medium.

[0037] The treatment system may bring the transparent medium into contact with the hairs to be treated. The medium may also be placed on the hairs outside the hair guide system.

[0038] The guide system and the light entry surface may define a treatment surface that surrounds the treated hair(s) on all sides, in at least one section taken transversely relative to the treated hair(s).

[0039] The treatment system may comprise a basin for recovering the transparent medium and also optionally a system for recirculating to the treatment space.

[0040] The treatment system may comprise a system for cooling the transparent medium, for example an exchanger in which circulates the medium or a cold source in contact with the medium.

[0041] The guide system may be arranged to calibrate the amount of hair contained in the treatment space. The cross section of this space has, for example, a thickness corresponding to a relatively small number of layers of hair, for example less than four layers.

[0042] The cross section of the treatment space has, for example, a depth of between 1 mm and 10 mm and a width of between 1 mm and 10 mm.

[0043] In one embodiment, the treatment system comprises a transparent wall that is mobile relative to the guide system. This guide system may define a hair-receiving canal, for example of rectangular cross section. The transparent wall may move with an optical output.

[0044] One or more orifices for delivering the fluid intended to constitute the medium may emerge into said canal, this or these orifices being located, for example, in the guide system. As a variant, the transparent wall moves with at least one fluid-delivering orifice, for example defined by a fluid spray nozzle. This or these orifices may be located upstream of the transparent wall, with regard to its movement, to ensure good impregnation of the hairs.

[0045] The system may comprise a delivery orifice emerging into a treatment space through which the hairs pass, this orifice being in communication with a reservoir and being rigidly attached to an optical output of the irradiation device.

[0046] The invention may be understood more clearly on reading the detailed description that follows, of nonlimiting embodiments thereof, and on examining the attached drawing, in which:

[0047] FIGS. **1***a* and **1***b* illustrate a first embodiment of the invention,

[0048] FIGS. **2***a* and **2***b* illustrate a second embodiment of the invention,

[0049] FIG. **3** represents, schematically and partially, an example of a treatment system, and

[0050] FIG. **4** is a schematic and partial cross section, along IV of FIG. **3**; and

[0051] FIG. **5** represents another example of a treatment system.

TRANSPARENT MEDIUM

[0052] The medium used according to the invention is preferably colorless, but it may be colored provided that it does not significantly absorb the working wavelength(s) of the irradiation light. For example, the medium may have an absorption less than or equal to a factor of 10 of the dominant wavelength of the irradiation light.

[0053] The transparent medium has a refractive index of greater than or equal to 1.3, preferably greater than or equal to 1.4, or even 1.41, 1.42, 1.43, 1.44 or 1.45, at 20° C.

[0054] The transparent medium may contain at least one organic compound in a mass content of greater than or equal to 1%.

[0055] The medium comprises, for example, at least one organic solvent chosen from alcohols, polyols, ketones and silicones, and mixtures thereof.

[0056] The medium contains, for example, ethanol with a refractive index of 1.36, glycerol with a refractive index of 1.47 or acetone with a refractive index of 1.36, for example in an amount by mass of greater than or equal to 25% relative to the total weight of the medium.

[0057] The medium may also be a fluid that solidifies.

[0058] Compositions that are capable of setting to a solid when the solvent evaporates off may be used, for example, a concentrated latex composition of a material that can coalesce by virtue of its Tg (glass transition temperature) and/or the presence of plasticizers. Moreover, use may be made of materials which, by chemical reaction or by physicochemical bonding, can set to a solid, for example a reactive silicone. The advantage of this approach is that it enables the light irradiation to be performed without the movements inherent in the manipulations causing the hairs to move relative to each other. Any risks of certain parts of the hair being overexposed and other parts underexposed, in particular when it is desired to perform several passages, are thus limited.

[0059] Preferably, the medium used is polar and has a capacity for wetting the surface of the hairs, for instance water or alcohol.

[0060] A fast-evaporating fluid may also be used, for instance a light alkane such as butane or pentane, an ether, for instance dimethyl ether or diethyl ether, a volatile silicone, acetone or an alkyl acetate.

[0061] The temperature of the transparent medium, at the time of irradiation, may be between −80° C. and 80° C.

[0062] The medium may be chemically inert with respect to the hairs. The medium may especially not produce any photochemical activation of the hairs. The medium may be free of oxidizing agent, especially H_2O_2.

[0063] If the illumination is in the UV spectrum, it is possible to use a material that filters out UV little or not at all.

Irradiation Device

[0064] The invention uses irradiation of keratin fibers via pulsed light, i.e. light pulses. These pulses may be generated in various ways, preferentially using a laser, but other sources, for example a flash lamp, may be envisioned provided that they are able to deliver pulses suited to the treatment to be performed.

[0065] The light used for the treatment according to the invention may have a relatively short pulse duration and a relatively high peak power.

[0066] The keratin fibers are, for example, exposed locally, at the same place, to several successive pulses. Advantageously, successive pulses make it possible to reduce the risk of damaging the keratin fibers, since the fibers are then irradiated gradually.

[0067] The pulse duration denotes the time for which the light power reaching the keratin fibers is greater than or equal to half of its peak power.

[0068] The pulse duration is, for example, between 10^{-16} s and 10^{-5} s and better still between 10^{-15} s and 10^{-7} s. The duration is, for example, greater than 5×10^{-12} s or less than or equal to 5×10^{-12} s.

[0069] The number of light pulses to which the same portion of keratin fibers is exposed is controlled, for example, as a function of the surface energy of the radiation that reaches the keratin fibers, the color of the keratin fibers and the treatment to be performed.

[0070] In a nonlimiting manner, in the case where one or more firings are performed on the same portion of hair, the firing rate is preferentially greater than or equal to 10 Hz and better still 100 Hz, or even greater than or equal to 200 Hz, 500 Hz or 1 kHz, and preferentially less than 100 kHz.

[0071] In a nonlimiting manner, the dominant wavelength of the light reaching the hairs may be between 300 nm and 10 000 nm and preferentially between 400 nm and 2000 nm. The dominant wavelength may be part of the visible, ultraviolet or infrared spectrum.

[0072] In a nonlimiting manner, various optical, absorbent or dichroic filters may be used so as to filter the light irradiating the fiber, for instance filters that screen out ultraviolet light or colored filters for protecting the natural or artificial color of the hairs. It will preferably be chosen to illuminate the hairs with a light that is not absorbed by certain sensitive compounds of the hairs. These colored filters make it possible, for example, to remove or greatly reduce certain components of light that correspond, for example, to the absorption band of hair dyes or to other absorption bands.

[0073] The characteristics of the emitted light are, for example, manually or automatically controlled, optical components being intended, for example, to be changed or moved so as to modify the focusing or the dominant wavelength of the light. The selection of the wavelength of the light projected onto the fibers to be treated is, for example, performed automatically or manually. A user can, for example, manually change an optical component such as a lens or a filter through which the light radiation passes during use.

[0074] A servomechanism may also be provided to perform automatic control of irradiation parameters, for example by controlling one or more optical components, this or these optical component(s) being, for example, moved by means of actuators piloted by one or more command signals. These command signals are transmitted, for example, by the computing unit of the treatment system as a function of data received from one or more sensors, for instance an optical sensor or a camera that can detect different hair colors or natures.

[0075] Automatic control may also be performed on the basis at least of answers to a questionnaire concerning the hair of the person to be treated.

[0076] The power supply of the irradiation device may be autonomous, for example portable and integrated into a handpiece.

[0077] In a nonlimiting manner, use may be made, to produce the light used for the treatment, of "attosecond" lasers whose pulse duration ranges from 10^{-18} to 10^{-15} sec, "femtosecond" lasers whose pulse duration ranges from 10^{-15} sec to 10^{-12} sec or "picosecond" lasers whose pulse duration ranges from 10^{-12} sec to 1 ns.

[0078] It is possible to use flash-pumped lasers, which generally have a pulse duration of about a nanosecond, or diode-pumped lasers, whose pulse duration generally ranges from one nanosecond to about a hundred nanoseconds.

[0079] The irradiation device comprises, for example, a laser with a cavity formed by two mirrors located on either side of a broad-band amplifier material, for example based on titanium-sapphire or based on ytterbium. The cavity may also be formed by an optical fiber made of an amplifier material. The irradiation device may comprise a mode-blocking device.

[0080] The irradiation device may comprise a lens associated with the laser, with a digital aperture of between, for example, 0.1 and 1, such as a lens used for the reading of optical storage disks. The irradiation device may also comprise a coupler for injecting the pumping light and a coupler for extracting the laser pulses. The pumping light is produced, for example, by a diode, but may also be produced by a flash lamp or by another laser.

[0081] Irrespective of the light generator used, each of the firings has, for example, a peak power of 1 MW to 1000 GW and better still 1 MW to 100 GW.

[0082] The irradiation device uses, for example, a laser whose mean electrical power is between 0.001 W and 50 W and which delivers, for example, peak powers ranging from 1 MW to 100 GW.

[0083] The number of firings to which the treated portion is subjected is, for example, between 1 and 10 000 firings and preferentially between 5 and 1000 firings.

[0084] The light reaching the keratin fibers has, for example, a fluence from about 1 to a few J/cm^2, for example less than 5 J/cm^2. The fluence may range, for example, from 0.1 mJ/mm^2 to 50 mJ/mm^2, for example as a function of the yields, the pulse durations or the adjustments made as a function of the hair type.

[0085] A user interface with, for example, a screen and one or more selection keys may make it possible to select among various operating modes and/or to modify the pulse durations, the energy supplied per firing and/or the firing frequency.

[0086] Nonlinear optical components may be used to double or triple the frequency or to spread out the spectrum of the light reaching the treated fibers.

[0087] The irradiation device may comprise a device for collimating the light beam and thus use a less powerful laser for an identical irradiation energy, but which is nevertheless sufficient to perform the desired hair treatment. The collimating device is, for example, adjustable so as to adjust the light flux reaching the keratin fibers. This adjustment is performed manually or automatically, for example as a function of the color of the keratin fibers to be treated or as a function of a desired degree of result. The collimating device may comprise several lenses, which are convergent and/or divergent.

[0088] The irradiation device may be used close to the hair or transportation of the light to the transparent medium may be performed. Various optical components may be used for transporting the light, such as collimation optics, one or more mirrors and/or optical deflectors and/or an optical channel such as one or more optical fibers.

[0089] An optical deflector may serve to orient the path of the light rays as a function of addressing data. The optical deflector is piloted, for example, by the computing unit to deliver the light beam onto the portion of the keratin fibers to be treated.

[0090] The irradiation device may also be equipped with means for confining or absorbing light, for trapping the light and preventing it from diffusing outside the treatment area.

[0091] The optical output may have any form, and may be single or multiple. The irradiation device comprises, for example, a circular optical output or an output in the form of one or more slits, which may have various profiles.

[0092] The optical output may be in contact with the transparent medium.

Treatment Process and System

[0093] The treatment process according to the invention may be applied to a single hair, but preferably to a lock of hair comprising, for example, between 100 and 10 000 hairs.

[0094] The process may be applied to a portion of this lock or to several separate portions of this lock, or even to the whole lock. The lock that is irradiated may comprise a single layer of irradiated hair, but the treatment is preferably performed with several superposed layers of hair, the treated thickness thus being greater than that of one hair.

[0095] FIGS. **1***a* and **2***a* illustrate the treatment of a lock comprising three superposed layers of hair, but, needless to say, the invention is not limited to a particular number of layers or to a particular regular arrangement of hairs within each layer, the stacking of the hairs in a treatment area possibly being irregular without the various stacked layers being clearly discernible.

[0096] In accordance with one aspect of the invention, at least one hair H is in contact with a transparent medium M that has a refractive index of greater than 1.3 and that contributes towards delivering the light to the hair(s) to be treated.

[0097] FIG. **1***b* illustrates the possibility for the medium M of not including all the thickness of the lock and of being in contact, for example, with only the surface layers thereof.

[0098] FIG. **2***b* illustrates the possibility of all of the lock being in contact with the transparent medium M.

[0099] The light is delivered to the hair by passing through an entry face I of the medium M that advantageously has a predefined shape, for example flat as illustrated in FIGS. **1***b* and **2***b*.

[0100] The entry surface of the medium through which the incident light passes during a firing is, for example, between 10 000 μm^2 and 100 cm^2.

[0101] The fact that the face I of entry into the medium M has a predefined shape makes it possible to control the penetration of light into the medium and thus to optimize the amount of light reaching the hairs. It is also possible to prevent a hair from being irradiated with a large amount of energy while it is not immersed in the medium.

[0102] All the hairs of the first surface layer may thus be located behind the entry surface I.

[0103] FIGS. **1***a* and **2***a* represent the outer surface of the medium M with an irregular shape to illustrate the fact that the light entry surface is not of predefined shape.

[0104] Many possibilities exist for giving the entry surface I a predefined shape.

[0105] It is possible, for example, to flatten or level off the medium so as to impose its shape on the entry face I, the levelling or flattening possibly being performed, for example, manually or automatically.

[0106] The user may, for example, move a treatment system member to level the surface of the medium.

[0107] The shape of the surface for the entry of light into the medium may also be defined with a transparent wall **10**, in contact with the medium M, as illustrated in FIGS. **3** and **4**.

[0108] These figures show, very schematically and partially, a treatment system **15** that comprises an optical channel **16** for delivering light up to the transparent wall **10** in contact with the medium M.

[0109] The hairs H are confined in a guide system **20** that at least partially defines the treatment space **21** containing the medium M. The thickness e of this treatment space **21** is, for example, between 1 mm and 5 mm, which can receive, for example, between 1 and 20 layers of hair, for example three layers.

[0110] The width L of the treatment space **21** is, for example, between 5 mm and 30 mm.

[0111] The medium M present in the treatment space **21** may be delivered therein in various ways.

[0112] For example, the medium M is deposited on the hairs before they enter the treatment space.

[0113] As a variant, the treatment space is fed with transparent medium via the guide system, for example via the sides of the canal in which the hairs extend, for example via one or more orifices **26** that are in communication with a source of the fluid intended to constitute the transparent medium.

[0114] Where appropriate, a recovery system, not shown, for instance a basin, may be arranged so as to recover the medium that flows via the longitudinal ends of the canal of the guide system, via which the hairs enter and leave. These longitudinal ends may optionally be provided with a sealing system, for example seals between which the hairs pass.

[0115] The treatment system may be arranged to exert a pressure or a tension on the hairs to be treated, so as to ensure good inclusion of the hairs in the transparent medium M.

[0116] In the example of FIG. **3**, the lock of hair is immobile relative to the guide system **20**. The transparent wall **10** can move longitudinally relative to the guide system **20** to treat the lock extending in the guide system.

[0117] On moving, the transparent wall **10** presses on the transparent medium M, which ensures its planarity on contact with the transparent wall **10**, and the absence of air also makes it possible to spread out the hairs present in the guide system.

[0118] The movement of the transparent wall **10**, which defines the optical output of the irradiation device, relative to the guide system may be effected manually or, as a variant, automatically, the treatment system comprising, for example, an actuator for moving the optical output in a manner slaved to the emission of the light pulses.

[0119] Optionally, the dispensing of the fluid intended to constitute the transparent medium can be slaved to the forward motion of the optical output, so as to make the dispensing of the fluid coincide with the positioning of the optical output.

[0120] It is also possible, in another variant, to arrange for the fluid not to be dispensed via the orifices of the guide system, but via a part of the treatment system that comprises the optical output. Preferably, the fluid is dispensed via at least one orifice that is located upstream of the optical output with regard to its direction of motion, in order for the fluid to have the time to impregnate the hairs before the arrival of the light.

[0121] In one variant illustrated in FIG. **5**, the optical output is rigidly attached to a container **40** filled with liquid intended to constitute the transparent medium. The treatment system **15** comprises a handpiece **42** on which is mounted a reservoir and which supports the optical output.

[0122] The hairs may pass through a treatment space in which emerges an orifice that is in communication with the reservoir.

[0123] The handpiece may be moved along the hairs.

[0124] The irradiation may take place automatically, as a function of the movement, and/or may be controlled by the operator.

[0125] Needless to say, the invention is not limited to the examples that have just been described.

[0126] The expression "comprising one" should be understood as being synonymous with "comprising at least one", unless otherwise mentioned.

1. A method for treatment of hair of the scalp, comprising:

exposing at least a portion of at least one hair of the scalp to at least one light pulse through a transparent medium that is fluid or that has solidified,

wherein

a refractive index of the transparent medium is greater than or equal to 1.3,

the transparent medium is in contact with the scalp hair and extending between the scalp hair and a surface for the entry of light into the medium.

2. The method according to claim **1**, wherein a shape of the light entry surface is defined by a transparent wall of an irradiation device in contact with the transparent medium.

3. The method according to claim **1**, wherein a shape of the light entry surface is defined by levelling or flattening the medium prior to the exposure to the light pulse.

4. The method according to claim **1**, wherein an entire section of at least one treated hair is included in the transparent medium.

5. The method according to claim **1**, wherein at least two layers of superposed hairs are included in the transparent medium and are simultaneously exposed to the light pulse(s).

6. The method according to claim **1**, wherein the treated scalp hair is confined in a guide system defining a treatment space comprising the scalp hairs and the transparent medium.

7. The method according to claim **7**, wherein the scalp hairs are packed into the treatment space.

8. The method according to claim **1**, wherein a peak power of the light pulse is greater than or equal to 10^5 W.

9. The method according to claim **1**, wherein the transparent medium comprises at least one organic compound in a mass content of greater than or equal to 25%.

10. The method according to claim **1**, wherein the transparent medium is dispensed on the scalp hairs from at least one orifice for delivering said transparent medium, occupying a variable position relative to the scalp hairs, between two light pulses.

11. The method according to claim **1**, wherein a refractive index of the medium is greater than or equal to 1.4.

12. The method according to claim **1**, wherein the scalp hairs are bleached, modified in shape or bleached and modified in shape.

13. The method according to claim **1**, wherein the duration of the pulses is greater than 5×10^{-12} s.

14. A scalp hair treatment system, comprising:

a source of pulsed light,

a source of a fluid or solidifiable transparent medium, having a refractive index of greater than or equal to 1.3,

a system for guiding the scalp hairs to be treated, configured to receive the scalp hairs to be treated,

wherein

the treatment system is configured to bring the transparent medium into contact with the scalp hairs to be treated.

15. The system according to claim **14**, wherein the treatment space exposed to the light pulses surrounds the treated scalp hair(s) on all sides, in at least one section taken transversely relative to the treated scalp hair(s).

16. The method according to claim **1**, wherein the surface for the entry of the light into the medium is of a predefined shape.

17. The system according to claim **14**, wherein the system is configured to define a surface of predetermined shape for entry of light into the medium.

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