

(51) International Patent Classification:
A61N 5/06 (2006.01)(21) International Application Number:
PCT/EP2017/058960(22) International Filing Date:
13 April 2017 (13.04.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
16165562.6 15 April 2016 (15.04.2016) EP
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MANN PATENT- UND RECHTSANWÄLTE PART-NERSCHAFT MBB; Dr. Mathias Ricker, Zweibrücken-
strasse 5-7, 80331 Munich (DE).(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN,
KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA,
MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG,
NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS,
RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY,
TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN,
ZA, ZM, ZW.(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ,
TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU,
TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE,
DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: MEDICAL IRRADIATION DEVICE

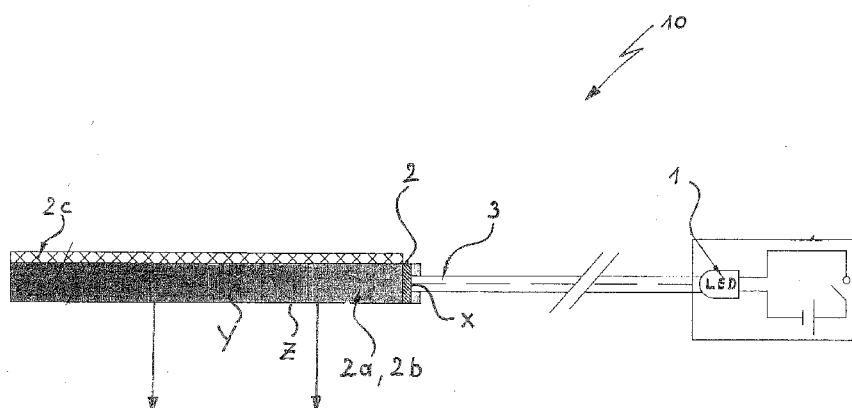


Fig. 1

(57) Abstract: Medical irradiation device, comprising: (A) first means comprising at least one OLED or LED configured to emit light; (B) second means comprising at least one luminescent material configured to emit light by converting said light emitted from said first means comprising at least one OLED or LED (A); wherein said luminescent material is a luminescent organic compound or a quantum dot-comprising material; (C) third means comprising an optical waveguide configured to guide said light emitted by said at least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B); wherein said third means (C) connects the first means (A) to the second means (B).

MEDICAL IRRADIATION DEVICE

FIELD OF THE INVENTION

[0001] The present invention relates to a medical irradiation device, in particular in the form of a medical patch, in which different types of emission spectra can be adjusted by exciting a luminescent material by means of an organic or inorganic light emitting diode such that the emitted light may be optimised for a predetermined application such as a therapeutic application. The therapeutic application may optionally include a cosmetic and / or an aesthetic application or result in such application.

BACKGROUND OF THE INVENTION

[0002] It is known to use organic light emitting diodes (OLEDs) or inorganic light emitting diodes (LEDs) for therapeutic applications such as light therapy. For example, light sources using LEDs for activating the formation of collagen are commercially available. Patches comprising LEDs such as (In,Ga)N LEDs emitting blue light for pain relief purposes are also commercially available.

[0003] EP 2 422 845 A1 relates to an apparatus for directing electromagnetic radiation into a respective pupil of at least one eye of a user. The apparatus comprises first radiation emitting means comprising at least one radiation emitting layer adapted to emit electromagnetic radiation and second radiation emitting means adapted to direct electromagnetic radiation into at least one eye and/or onto at least one eyelid of a user. A light guide is adapted to receive radiation emitted by the first radiation emitting means and to direct at least part of the radiation to the second radiation emitting means, wherein a total surface area of the first emitting radiation means from which radiation is emitted is larger than a total cross sectional area of a

beam of radiation entering the or each pupil of the user in use, in a direction transverse to an optical axis of the beam.

[0004] US 2007/0170842 A1 relates to an illumination device with at least one LED as the light source, the LED emitting primary radiation in the range from 370 to 430 nm of the optical spectral region (peak wavelength), this radiation being partially or completely converted into radiation of a longer wavelength by three phosphors which are exposed to the primary radiation from the LED and which emit in the blue, green and red spectral regions, so that white light is formed. The conversion is achieved at least with the aid of a phosphor which emits blue light with a wavelength maximum at 440 to 485 nm, and with the aid of a phosphor which emits green light with a wavelength maximum at 505 to 550 nm, and with the aid of a phosphor which emits yellow to red light with a wavelength maximum at 550 to 670 nm.

[0005] WO 2011/135502 A1 relates to a phototherapy patch for relieving nociceptive pain of a body part by illumination of at least part of the body part. The patch is formed for conforming to at least part of the body part. The patch comprises a first light source for emitting light. The patch is arranged for illuminating at least a portion of the body part with light from the first light source. The first light source is configured to emit light with a wavelength in the range of 430 nm to 475 nm.

[0006] WO 2013/105007 A1 relates to a light emitting textile device comprising a first textile sheet comprising conductors and at least one light source connected to the conductors and being configured to emit first light at a first wavelength. The device comprises a second textile sheet arranged over at least a portion of the first sheet and being configured to be illuminated by the first light. The second sheet comprises a photoluminescent conversion material configured to convert incident first light at the first wavelength to emitted second light at a second wavelength, different from the

first wavelength. The device is configured to illuminate an object with at least a portion of at least the second light.

[0007] WO 2014/184038 A1 relates to an UV radiation device, comprising an LED comprising a nitride material which is arranged to emit first UV radiation in a wavelength range of 200 nm to 300 nm and a luminescent material doped with at least one of the following activators selected out of the group Eu^{2+} , Ce^{3+} , Pr^{3+} , Nd^{3+} , Gd^{3+} , Tm^{3+} , Sb^{3+} , Tl^{+} , Pb^{2+} and Bi^{3+} , wherein the luminescent material is configured to convert at least a part of the primary UV radiation into secondary UV radiation, the primary UV radiation and the secondary UV radiation having a different spectral distribution.

[0008] US 2013/0103123 A1 relates to methods and devices related to wound healing using phototherapy. A light-emitting layer comprises a luminescent compound that has a peak emission of about 620 nm to about 640 nm.

[0009] WO 2010/004500 A1 relates to a cosmetic appliance. It has a housing and comprises a light source module arranged to emit light in a predefined first wavelength range through the use of one or more light sources, e.g. LEDs. An optical module is arranged to deliver light emitted by the light source module to a user's body part to achieve a first cosmetic effect. As an example, the cosmetic effect targeted may be tanning (using light in the range 400 to 440 nm), acne reduction (400 to 440 nm), or psoriasis reduction (300 to 360 nm). The optical module comprises an adjustable color converting device arranged to convert light of the first wavelength range to light in a predefined second wavelength range to achieve a second cosmetic effect, for instance, skin rejuvenation (580 to 660 nm).

[0010] WO 2011/117791 A1 relates to a LED-based lighting device comprising a plurality of luminescent materials, wherein the luminescent materials are excitable by light from the LED, and wherein the LED and the luminescent materials are arranged

to emit light in the wavelength ranges 440 to 490 nm, 500 to 580 nm, 590 to 680 nm, 690 to 850 nm, 850 to 950 nm and 000 to 1200 nm. Such LED-based lighting device may be used for indoor lighting, for medical treatment of mental diseases, and for mood lighting.

[0011] WO 2012/127389 A1 discloses a light guide material. The light guide material comprises a carrier material provided with a photoluminescent material. The carrier material is arranged for receiving and transmitting first light from a light source having a first wavelength. The photoluminescent material is arranged for converting at least a portion of said received first light into second light having a second wavelength, different from the first wavelength. At least a portion of the carrier material is a silicone material and at least a portion of the photoluminescent material is an organic photoluminescent material. An optical device with a light guide comprising such light guide material, and a method of manufacturing such light guide material are also provided.

[0012] US 2013/304162 A1 discloses an apparatus for directing electromagnetic radiation into a respective pupil of at least one eye of a user. The apparatus comprises first radiation emitting means comprising at least one radiation emitting layer adapted to emit electromagnetic radiation and second radiation emitting means adapted to direct electromagnetic radiation into at least one eye and/or onto at least one eyelid of a user. A light guide is adapted to receive radiation emitted by the first radiation emitting means and to direct at least part of the radiation to the second radiation emitting means, wherein a total surface area of the first emitting radiation means from which radiation is emitted is larger than a total cross sectional area of a beam of radiation entering the or each pupil of the user in use, in a direction transverse to an optical axis of the beam.

[0013] US 2013/344454 A1 discloses an appliance for dermatological or cosmetic treatment of a patient which comprises a base body, which has a radiation source for emitting light in a wavelength range between 350 nm and 1000 nm. An intermediate piece sitting on the base body conveys the light from the radiation source in the direction of a body region of the patient to be treated.

[0014] US 2012/182758 A1 discloses the optical transmission of a light guide assembly in an optical illumination apparatus achieved by one or more insulation layers which sheath a rigid or flexible light guide rod of the light guide assembly and/or the coupling of light emitted from a radiation source into the light input surface of the light guide rod by an adapter element.

[0015] US 2012/289885 A1 discloses a phototherapy system for treating a treatment region having a treatment surface. The phototherapy system comprises an optical device. The optical device includes a light source generating source light, an emission surface emitting emitted light, and a sheet waveguide. The light source is coupled to direct the source light into the sheet waveguide. The sheet waveguide has a plurality of light extraction features that direct light out of the sheet waveguide. The phototherapy system may further comprise a treatment patch and a photoactive compound within the treatment region.

[0016] US 2011/275978 A1 discloses dressings, such as patches and bandages, and other devices and systems that deliver nitric oxide.

[0017] WO 2009/017794 A1 discloses illumination assemblies, components, and related methods. An illumination assembly can include at least one solid state light-emitting device, and at least one light guide including a light homogenization region configured to receive light emitted by the solid state light-emitting device and including a light output boundary. The light homogenization region substantially uniformly distributes light outputted over the light output boundary. A wavelength

converting material can be disposed within at least a portion of the light homogenization region.

[0018] US 2013/296976 A1 discloses a light converting device for receiving source light within a source wavelength range, converting the source light into an interim light, and converting the interim light into a converted light. The lighting device may include an enclosure with an application of a wide production conversion coating and a narrow production conversion coating to perform a series of wavelength conversion operations on a source light to produce a converted light.

[0019] WO 2010/150202 A2 discloses an illumination apparatus which includes a substantially planar waveguide, a plurality of light sources embedded within the in-coupling region of the waveguide, and a film disposed over the out-coupling region of the waveguide. The film has a thickness less than approximately 100 μm and comprises or consists essentially of a photoluminescent material. The photoluminescent material converts a portion of light emitted by at least one of the light sources to a different wavelength.

[0020] EP 2 383 017 A1 discloses a phototherapy patch for relieving nociceptive pain of a body part by illumination of at least part of the body part. The patch is formed for conforming to at least part of the body part. The patch comprises a first light source for emitting light. The patch is arranged for illuminating at least a portion of the body part with light from the first light source. The first light source is configured to emit light with a wavelength in the range of 430 nm to 475 nm.

[0021] US 4 907 132 A discloses light emitting panel assemblies and method of making same, and which include one or more layers of woven fiber optic material having disruptions or bends at discrete locations along the length of the fibers to allow light to be emitted therefrom. Only selected areas of the disruptions or bends

are coated with a suitable coating material that has a refractive index that changes the attenuation of the light emitted from the selected areas.

OBJECTS OF THE INVENTION

[0022] One object of the present invention is the provision of an irradiation device, which may be used in a therapeutic, cosmetic and / or aesthetic application such that the emitted light may be specifically adjusted in a tailor-made manner to the intended use.

SUMMARY OF THE INVENTION

[0023] This object is achieved with an irradiation device, in particular in the form of a medical patch, comprising first means comprising at least one OLED or LED which is configured to emit light, and a second means comprising at least one luminescent material which is configured to emit light by converting said light emitted from said at least one OLED or LED to a longer wavelength range. This means that at least one luminescent material emits said light when being excited by the emitted light from said at least one OLED or LED. By means of a suitable selection of a combination of said at least one OLED or LED with said at least one luminescent material, it is possible to generate a radiation, i.e. light, defined by its wavelength range or emission maximum, which is appropriate for the intended use.

[0024] According to the invention, the first means and the second means are connected by third means, which comprises an optical waveguide. Said waveguide comprised in the third means is beneficial for decoupling the heat emitted from said OLED or LED from the luminescent material. This allows that e.g. only a light therapy or phototherapy, optionally including a cosmetic and /or aesthetic application, may be performed without applying heat.

[0025] The first means and the second means are connected to one another by means of a waveguide which may be detachable from said first means and / or said second means. This is of particular advantage since - depending on the intended use - via the detachable optical waveguide a specific second means may be substituted by another specific second means while keeping the same excitation source. This is in particular advantageous in view of economic aspects. Contrary to this, when the use changes, in arrangements known from the prior art as discussed above, the substitution of a specific emitting material by another specific emitting material would at the same time also require the substitution of the excitation source, i.e. the whole arrangement.

[0026] Specifically, the invention relates to the following items 1 to 19:

1. Medical patch, comprising:

- a light entry portion (X);
- a light converting portion (Y); and
- a light emitting portion (Z);

and further comprising first means (A), second means (B) and third means (C);

the light entry portion (X) being configured to receive light from said third means (C) comprising an optical waveguide;

the light converting portion (Y) comprising said second means (B) comprising at least one luminescent material being configured to emit light by converting light emitted from said first means (A) comprising at least one OLED or LED;

the light emitting portion (Z) being configured to contact and irradiate a skin, a tissue or a muscle, or a combination of two or three thereof;

wherein

said third means (C) comprising said optical waveguide receives light from said first means (A) comprising at least one OLED or LED being configured to emit said light;

said third means (C) comprising said optical waveguide is configured to guide said light emitted by said at least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B);

wherein said third means (C) connects said first means (A) to said second means (B); and

wherein said optical waveguide comprised in said third means (C) is configured to be detachable from said first means (A) or from said second means (B) or from said first means (A) and said second means (B).

2. Medical patch according to item 1, wherein said first means (A) and said second means (B) are not in physical contact with one another.
3. Medical patch according to any one of the preceding items, wherein said third means (C) receives the light from said first means (A) and emits the light in a first light direction, wherein the second means (B) is configured to emit light in a second light direction, which differs from the first light direction by an angle α , preferably by $0^\circ < \alpha \leq 90^\circ$.
4. Medical patch according to any one of the preceding items, wherein

said at least one LED comprised in the first means (A) comprises (In,Ga)N or (Al,In,Ga)N and is configured to emit light in the wavelength range of from 370 to 480 nm;

wherein said at least one luminescent material comprised in the second means (B) comprises an inorganic compound selected from the group comprising or consisting of:

$\text{Sr}_4\text{Al}_{14}\text{O}_{25}:\text{Eu}^{2+}$, $\text{BaSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $(\text{Ba},\text{Sr})_2\text{SiO}_4:\text{Eu}^{2+}$, $\text{Lu}_3(\text{Al},\text{Ga},\text{Sc})_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Gd}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{SrSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $\text{SrGa}_2\text{S}_4:\text{Eu}^{2+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Tb}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{CaSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $\text{La}_3\text{Si}_6\text{N}_{11}:\text{Ce}^{3+}$, $(\text{Y},\text{Gd})_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{SrLi}_2\text{SiO}_4:\text{Eu}^{2+}$, $\text{Ba}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{Ca}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{Sr}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{LiSrAl}_3\text{N}_4:\text{Eu}^{2+}$, $(\text{Ca},\text{Sr})\text{AlSiN}_3:\text{Eu}^{2+}$, $\text{CaS}:\text{Eu}^{2+}$, $\text{Mg}_4\text{GeFO}_{5.5}:\text{Mn}^{4+}$, $\text{MgAl}_2\text{O}_4:\text{Cr}^{3+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Cr}^{3+}$, $\text{GdMgAl}_{11}\text{O}_{19}:\text{Cr}^{3+}$, $\text{Al}_2\text{O}_3:\text{Cr}^{3+}$, $\text{BaMgAl}_{10}\text{O}_{17}:\text{Cr}^{3+}$, $\text{SrB}_4\text{O}_7:\text{Sm}^{2+}$, $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Cr}^{3+}$, $\text{LiAl}_5\text{O}_8:\text{Cr}^{3+}$, $\text{GdAlO}_3:\text{Cr}^{3+}$, $\text{Y}_3\text{Ga}_5\text{O}_{12}:\text{Cr}^{3+}$, $\text{LaAlO}_3:\text{Cr}^{3+}$, $\text{Gd}_3\text{Ga}_5\text{O}_{12}:\text{Cr}^{3+}$, $\text{Mg}_2\text{SiO}_4:\text{Cr}^{3+}\text{Li}^+$, $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Gd}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Tb}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Ca}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Sr}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Ba}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Ca}_2\text{Al}_2\text{SiO}_7:\text{Ce}^{3+}$, $\text{YBO}_3:\text{Ce}^{3+}$, $\text{CaY}_2\text{Al}_2\text{O}_7:\text{Ce}^{3+}$, $\text{CaAl}_2\text{Si}_2\text{O}_8:\text{Eu}^{2+}$, $\text{CaAl}_2\text{O}_4:\text{Eu}^{2+}$, $\text{CaMgSi}_2\text{O}_6:\text{Eu}^{2+}$, $\text{Y}_2\text{SiO}_5:\text{Ce}^{3+}$, $\text{Sr}_2\text{ZnSi}_2\text{O}_7:\text{Eu}^{2+}$, $\text{Sr}_3\text{Al}_{10}\text{SiO}_{20}:\text{Eu}^{2+}$, $\text{Sr}_2\text{MgSi}_2\text{O}_7:\text{Eu}^{2+}$, $\text{SrAl}_4\text{O}_7:\text{Eu}^{2+}$, $\text{Sr}_3\text{MgSi}_2\text{O}_8:\text{Eu}^{2+}$, $\text{ZnO}:\text{Zn}$, $\text{Ba}(\text{Zr},\text{Hf})\text{Si}_3\text{O}_9:\text{Eu}^{2+}$, $\text{SrSiAl}_2\text{O}_3\text{N}:\text{Eu}^{2+}$, Mg_2SnO_4 , $\text{Ca}_9\text{Y}(\text{PO}_4)_7$, $\text{Y}_3\text{AlGa}_4\text{O}_{12}:\text{Ce}^{3+}$, ZnGa_2O_4 , $\text{Ba}_2\text{MgSi}_2\text{O}_7:\text{Eu}^{2+}$, $\text{Lu}_3\text{Al}_2\text{Ga}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{CaY}_2\text{Al}_4\text{GeO}_{12}:\text{Ce}^{3+}$, $\text{CaY}_2\text{Al}_4\text{GeO}_{12}:\text{Ce}^{3+}$, ZnAl_2O_4 , $\text{Y}_3\text{Al}_2\text{Ga}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{Lu}_3\text{ScAl}_4\text{O}_{12}:\text{Ce}^{3+}$, $\text{SrSi}_2\text{AlN}_3\text{O}_2:\text{Eu}^{3+}$, $\text{CaSc}_2\text{O}_4:\text{Ce}^{3+}$, $\text{Y}_3\text{Al}_3\text{Ga}_2\text{O}_{12}:\text{Ce}^{3+}$, $\text{Zn}_2\text{SiO}_4:\text{Mn}^{2+}$, $(\text{Sr}_{0.5}\text{Ba}_{0.5})_2\text{SiO}_4:\text{Eu}^{2+}$, $\text{Y}_3\text{Al}_4\text{GaO}_{12}:\text{Ce}^{3+}$, $\text{Zn}_2\text{GeO}_4:\text{Mn}^{2+}$, $\text{CaLu}_2\text{Al}_4\text{SiO}_{12}:\text{Ce}^{3+}$, $\text{Y}_2\text{GdAl}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{CaY}_2\text{Al}_4\text{SiO}_{12}:\text{Ce}^{3+}$, $\text{Mg}_3\text{Y}_2\text{Ge}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{YGd}_2\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Mg}_3\text{YGdGe}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{Mg}_3\text{Y}_{0.25}\text{Gd}_{0.75}\text{Ge}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{Ba}_2\text{Mg}(\text{BO}_3)_2:\text{Yb}^{2+}$, $\text{Mg}_3\text{Gd}_2\text{Ge}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{Mg}_3\text{Gd}_2\text{Ge}_2\text{SiO}_{12}:\text{Ce}^{3+}$, $\text{LiEu}(\text{Mo},\text{W})_2\text{O}_8:\text{Eu}^{3+}$, $\text{Sr}[\text{Mg}_3\text{SiN}_4]:\text{Eu}^{2+}$, $\text{SrSi}_2\text{N}_2\text{O}_2:\text{Yb}^{2+}$, $\text{Sr}[\text{LiAl}_3\text{N}_4]:\text{Eu}^{2+}$, $\text{Mg}_{14}\text{Ge}_5\text{O}_{24}:\text{Mn}^{4+}$, $\text{K}_2\text{Ge}_4\text{O}_9:\text{Mn}^{4+}$, $\text{Li}_2\text{Ge}_4\text{O}_9:\text{Mn}^{4+}$, $\text{Na}_2\text{CaGe}_5\text{SiO}_{14}:\text{Mn}^{4+}$, $\text{Ca}_2\text{GdNbO}_6:\text{Mn}^{4+}$, $\text{Ca}_2\text{YNbO}_6:\text{Mn}^{4+}$, $\text{Ca}_2\text{LuNbO}_6:\text{Mn}^{4+}$, $\text{Sr}_3\text{Al}_2\text{Ge}_4\text{O}_{14}:\text{Mn}^{4+}$, $\text{Ca}_2\text{ScNbO}_6:\text{Mn}^{4+}$, $\text{Ca}_2\text{LaNbO}_6:\text{Mn}^{4+}$, $\text{Y}_2\text{MgTiO}_6:\text{Mn}^{4+}$, $\text{LaScO}_3:\text{Mn}^{4+}$, $\text{La}_3\text{Mg}_2\text{TaO}_9:\text{Mn}^{4+}$, $\text{LaMgTiO}_6:\text{Mn}^{4+}$, $\text{MgLa}_2\text{GeO}_6:\text{Mn}^{4+}$,

$\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Tb}^{3+}\text{Yb}^{3+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Tb}^{3+}\text{Yb}^{3+}$, $\text{LaMgAl}_{11}\text{O}_{19}:\text{Mn}^{4+}$, or a mixture of two or more thereof; or

wherein said at least one luminescent material comprised in the second means (B) comprises a luminescent organic compound or a quantum dot-comprising material; preferably selected from the group comprising or consisting of:

a perylene dye, a triphenylene dye, a naphthalimide dye, a xanthene dye, a phenoxazine dye, an acridine dye, an anthracene dye, a phenazine dye, or a coumarin dye, or two or more thereof;

or wherein said at least one luminescent material comprised in the second means (B) comprises one or more of said inorganic compounds and one or more of said organic compounds or quantum dot-comprising materials.

5. Medical patch according to any one of the preceding items, wherein said luminescent material comprised in the second means (B) is distributed such in said second means (B) to form one or more concentration gradients.
6. Medical patch according to any one of the preceding items, said second means (B) comprises cover means (G), wherein the second means (B) has a light emitting surface, and the cover means (G) prevents light being emitted from other surfaces of the second means (B) than said light emitting surface.
7. Medical patch according to any one of the preceding items, wherein said optical waveguide comprised in the third means (C) is in the form of a fiber.
8. Medical patch according to item 7, wherein said fiber comprises or consists of a fiber selected from the group consisting of: hollow optical fiber, photonic-crystal fiber or hollow photonic-crystal fiber, or two or more thereof.

9. Medical patch according to any one of the preceding items, wherein at least a part of said optical waveguide comprised in the third means (C) forms at least a part of the second means (B).
10. Medical patch according to any one of the preceding items, wherein said second means (B) comprises at least one optical element (F) which is configured to increase the efficiency of the light output of said at least one luminescent material comprised in the second means (B).
11. Medical patch according to item 10, wherein said at least one optical element (F) comprises or consists of a light distributing structure that distributes the light emitted from said at least one first means (A).
12. Medical patch according to item 10 or 11, wherein said at least one optical element (F) comprises or consists of a reflector device, wherein said reflector device is arranged such to at least partially enclose an area of said second means (B) comprising said at least one luminescent material.
13. Medical patch according to any one of the preceding items, comprising at least one of the following for detachably connecting said waveguide comprised in the third means (C) to said first means (A) or to said a second means (B) or to the first means (A) and the second means (B):
 - a connector system comprising a plug and a socket;
 - a receiving portion for receiving an end portion of said waveguide, wherein said receiving portion comprises a cavity configured to contain an optical gel, and preferably containing said optical gel; and/or
 - a cleavable fusion splice.
14. Medical irradiation device comprising:

first means (A) comprising at least one OLED or LED configured to emit light;

second means (B) comprising at least one luminescent material configured to emit light by converting said light emitted from said at least one OLED or LED (A);

third means (C) comprising an optical waveguide configured to guide said light emitted by said at least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B);

wherein said third means (C) connects the first means (A) to the second means (B);

wherein said third means (C) connects the first means (A) to the second means (B); and wherein said optical waveguide comprised in said third means (C) is configured to be detachable from the first means (A) or from the second means (B) or from the first means (A) and the second means (B).

15. Luminescent material for use in a therapeutic application, wherein the therapeutic application comprises or consists of the irradiation of a skin, a tissue or a muscle, or a combination of two or three thereof, of a subject, the luminescent material being comprised in a medical patch as defined in item 1 or in a medical device as defined in item 14,

wherein said light emitted by said at least one luminescent material comprised in said second means (B) is used for said irradiation of a skin, a tissue or a muscle, or a combination of two or three thereof, of said subject.

16. Luminescent material for use according to item 15, wherein said irradiation is a light therapy, photodynamic therapy, or heat therapy, or a combination of two or more thereof.

17. Luminescent material for use according to any one of items 15 to 16, wherein said therapeutic application comprises a cosmetic application or aesthetic application or a cosmetic and an aesthetic application.
18. Method of performing a therapeutic treatment or a cosmetic treatment or an aesthetic treatment or a combination of two or more thereof of a subject, the method comprising: directing light emitted from said second means (B) of the medical patch as defined in any one of items 1 to 13 onto the subject, wherein said medical patch contacts said subject.
19. Method of performing a therapeutic treatment or a cosmetic treatment or an aesthetic treatment or a combination of two or more thereof of a subject, the method comprising: directing light emitted from said second means (B) of the medical irradiation device as defined in item 14 onto the subject.

[0027] In one embodiment, said therapeutic application is selected from the group consisting of: light therapy, photodynamic therapy, or heat therapy, or a combination of two or three thereof.

[0028] In one embodiment, said irradiation is a therapy of stressed muscles, relaxation of muscles, improvement of perfusion, reduction of viscosity of synovial fluid, improvement of collagen formation, treatment of DNA damages, reduction of inflammatory skin reactions, treatment of atopic dermatitis, and/or treatment of pruritus.

[0029] In one embodiment, said method comprises a cosmetic and / or aesthetic application.

[0030] In one embodiment, said cosmetic and / or aesthetic application is selected from the group consisting of: removal of macula, removal of tattoos, removal of hairs (epilation), reduction of wrinkles, or reduction of scar tissue, treatment of hair loss,

treatment or amelioration of cellulite, non-invasive treatment to improve aesthetic impression of under-chin, neck and décolletage.

[0031] In one embodiment, said method is a cosmetic and / or aesthetic application.

[0032] In one embodiment of said cosmetic and / or aesthetic application, said cosmetic and / or aesthetic application is selected from the group consisting of: removal of macula, removal of tattoos, removal of hairs (epilation), reduction of wrinkles, or reduction of scar tissue, treatment of hair loss, treatment or amelioration of cellulite, non-invasive treatment to improve aesthetic impression of under-chin, neck and décolletage.

Brief Discussion of the Figures

Fig. 1 shows an exemplary irradiation device suitable for use in a therapeutic application such as the irradiation of a skin, a tissue or a muscle, or a combination of two or three thereof, of a subject.

Fig. 2 shows another exemplary irradiation device suitable for use in a therapeutic application such as the irradiation of a skin, a tissue or a muscle, or a combination of two or three thereof, of a subject.

DETAILED DESCRIPTION OF THE INVENTION

[0033] In the following, all terms in quotation marks are defined in the meaning of the invention.

[0034] ***First aspect: Medical patch***

[0035] According to a ***first aspect***, the invention relates to a medical patch.

[0036] The term “*patch*” in its broadest meaning encompasses any means that can be attached to a certain part of the skin of a human, or can be located close to a certain part of the skin of a human. Thus, said means may be an article of manufacture having a length, a depth and a width by means of which a certain part of the skin of a human can be covered. According to the invention, said luminescent material is comprised in said patch.

[0037] The term “*patch*” e.g. encompasses terms such as “*pad*”, “*cushion*”, “*template*” or “*screen*”.

[0038] Specifically, the invention relates to a medical patch, comprising:

a light entry portion (X);
a light converting portion (Y); and
a light emitting portion (Z);

- (X) being configured to receive light from third means (C) comprising an optical waveguide;
- (Y) comprising second means (B) comprising at least one luminescent material configured to emit light by converting light emitted from at least one OLED or LED (A);
- (Z) being configured to contact and irradiate a skin, a tissue or a muscle, or a combination of two or three thereof.

[0039] In one embodiment, said third means (C) comprising an optical waveguide receives light from said first means (A) comprising at least one OLED or LED configured to emit said light.

[0040] In another embodiment, said light converting portion (Y) comprises second means (B) comprising at least one luminescent material configured to emit light by converting said light emitted from said at least one OLED or LED (A).

[0041] In another embodiment, said third means (C) comprising said optical waveguide is configured to guide said light emitted by said at least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B).

[0042] In another embodiment, said third means (C) connects the first means (A) to the second means (B).

[0043] ***Second aspect: Medical irradiation device***

[0044] The invention further relates to an irradiation device comprising:

first means (A) comprising at least one OLED or LED configured to emit light;

second means (B) comprising at least one luminescent material configured to emit light by converting said light emitted from said at least one OLED or LED (A); wherein said luminescent material is a luminescent organic compound or a quantum dot-comprising material;

third means (C) comprising an optical waveguide configured to guide said light emitted by said at least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B);

wherein said third means (C) connects the first means (A) to the second means (B).

[0045] In a preferred embodiment, said irradiation device is a medical irradiation device. Accordingly, said irradiation device is used in a medical application.

[0046] ***Third aspect: Luminescent material for use***

[0047] The invention further relates to a luminescent material for use in the irradiation of a skin, a tissue or a muscle, or a combination of two or three thereof, of a subject, the luminescent material being comprised in an irradiation device, the irradiation device comprising:

first means (A) comprising at least one OLED or LED configured to emit light;

second means (B) comprising at least one luminescent material configured to emit light by converting said light emitted from said at least one OLED or LED (A);

third means (C) comprising an optical waveguide configured to guide said light emitted by said at least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B);

wherein said third means (C) connects the first means (A) to the second means (B);
and

wherein said light emitted by said at least one luminescent material comprised in said second means (B) is used for said irradiation of a skin, a tissue or a muscle, or a combination of two or three thereof, of said subject.

[0048] The term "*comprising*" as used herein encompasses the term "*having*" or "*including*".

[0049] Means

[0050] The term "*means*" encompasses any conceivable equipment, device or apparatus which is configured or adapted to the intended use, e.g. first means (A) comprising at least one OLED or LED configured or adapted to emit light; or second means (B) comprising at least one luminescent material configured to emit light by converting said light emitted from said at least one OLED or LED (A); or third means (C) comprising an optical waveguide configured to guide said light emitted by said at

least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B).

[0051] The term “*configured to*” is synonymously used with the term “*adapted to*” or “*arranged to*”.

[0052] In one embodiment, said first means (A) and said second means (B) are not in physical contact with one another, i.e. said first and said second means are physical separated from one another.

[0053] In one embodiment, at least a part of said second means (B) is configured to be attachable to a subject or to the skin of a subject. Attaching may be effected by means of suitable attaching means such as a tape.

[0054] In still another embodiment, said second means (B) is configured to emit light wherein the third means (C) receives the light from the first means (A) and emits the light in a first light direction, wherein the second means (B) is configured to emit light in a second light direction, which differs from the first light direction, preferably in an angle of from 0° to 90° or more than 0° and equal or less than 90°.

[0055] The term “*light direction*” of emitted light is understood to be the direction of the geometrical centre of the direction of the maximum light intensity in case of a non-parallel light beam.

[0056] OLED and LED

[0057] The term “*OLED*” encompasses a light emitting diode based on an organic material.

[0058] The term “*LED*” encompasses a light emitting diode based on an inorganic semiconductor chip.

[0059] The term "*light*" is synonymously used with the term "*radiation*" or "*optical radiation*". The term "*optical radiation*" covers a wavelength range of from 100 nm to 1 mm.

[0060] The term "*at least one OLED or LED*" encompasses an OLED- or LED-array.

[0061] In one embodiment, the term "*OLED- or LED-array*" encompasses an arrangement of more than one OLED or LED. In one embodiment, said OLEDs or LEDs are arranged in the array in rows or columns or rows and columns.

[0062] In one embodiment, the light emitting diode is based on an inorganic material.

[0063] In one embodiment, said LED is represented by the general formula MZ, wherein M represents at least two of Al, In, or Ga, and Z represents N or P.

[0064] Accordingly, in one embodiment, said irradiation device comprises:

first means (A) comprising at least one LED based on a compound of the general formula MZ, wherein M represents at least two of Al, In, or Ga, and Z represents N or P;

second means (B) comprising at least one luminescent material which is configured to emit light in a wavelength range of from 400 to 4,000 nm by converting said light emitted from said at least one LED (A).

[0065] In one embodiment, said LED comprised in the first means (A) comprises at least two of the elements selected from Al, In, and Ga in combination with N.

[0066] In one embodiment, said LED comprised in the first means (A) comprises (In,Ga)N or (Al,In,Ga)N.

[0067] LEDs comprised in the first means (A) based on (In,Ga)N or (Al,In,Ga)N are known. Such LEDs may emit blue light in the wavelength range of from 370 to 480 nm.

[0068] In another embodiment, said LED comprised in the first means (A) comprises at least two of the elements selected from Al, In and Ga in combination with P.

[0069] In one embodiment, said LED comprised in the first means (A) comprises (In,Ga)P or (Al,In,Ga)P.

[0070] LEDs comprised in the first means (A) based on (In,Ga)P or (Al,In,Ga)P are known. Such LEDs may emit light in the range of from 550 to 800 nm.

[0071] In one embodiment, said medical patch or irradiation device comprises:

first means (A) comprising at least one LED based on (In,Ga)P or (Al,In,Ga)P configured to emit light in the wavelength range of from 550 to 800 nm;

second means (B) comprising at least one luminescent material configured to emit light in a wavelength range of from 600 to 4,000 nm by converting said light emitted from said at least one LED comprised in the first means (A).

[0072] In one embodiment, said irradiation device comprises

first means (A) comprising at least one LED based on (In,Ga)N or (Al,In,Ga)N or (In,Ga)P or (Al,In,Ga)P;

second means (B) comprising at least one luminescent material configured to emit light in a wavelength range of from 400 to 4,000 nm by converting said light emitted from said at least one LED comprised in the first means (A).

[0073] In one embodiment, said medical patch or (medical) irradiation device comprises:

first means (A) comprising at least one LED based on (In,Ga)N or (Al,In,Ga)N configured to emit light in the wavelength range of from 370 to 480 nm;

second means (B) comprising at least one luminescent material configured to emit light in a wavelength range of from 400 to 4,000 nm by converting said light emitted from said at least one LED (A).

[0074] In one embodiment, said medical patch or (medical) irradiation device comprises:

first means (A) comprising at least one LED based on (In,Ga)P or (Al,In,Ga)P configured to emit light in the wavelength range of from 550 to 800 nm;

second means (B) comprising at least one luminescent material configured to emit light in a wavelength range of from 600 to 4,000 nm by converting said light emitted from said at least one LED comprised in the first means (A).

[0075] Luminescent material

[0076] The term "*luminescent material*" relates to any material that is suitable to convert the light emitted by said OLED or LED comprised in the first means (A). The term "*luminescent material*" further encompasses the terms "*luminescent substance*" and "*luminescent composition*".

[0077] The term "*luminescent material*" is also synonymously used with the term "*photoconversion material*", and also encompasses terms such as "*fluorescent material*" or "*phosphorescent material*" or "*luminescent converter*".

[0078] The term “*luminescent material*” comprises the terms “*luminescent substance*” or “*luminescent compound*”.

[0079] In general, said luminescent material comprised in the second means (B) converts said light to a light having a longer wavelength than the exciting light emitted from the at least one OLED or LED comprised in the first means (A).

[0080] In one embodiment, the luminescent material comprised in the second means (B) converts said emitted light to cyan or green or yellow or amber or red light or light in the NIR region (Near Infrared).

[0081] In one embodiment, said luminescent material comprised in the second means (B) is selected from one or more of compounds emitting light in the color cyan.

[0082] In one embodiment, said luminescent material comprised in second means (B) is selected from one or more of the inorganic compounds listed in Table 1:

[0083] Table 1

Luminescent material	Emission colour	Emission maximum at [nm]
$\text{Sr}_4\text{Al}_{14}\text{O}_{25}:\text{Eu}^{2+}$	cyan	490
$\text{BaSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$	cyan	495
Mg_2SnO_4	cyan	499
$\text{Ca}_9\text{Y}(\text{PO}_4)_7$	cyan	500

[0084] In another embodiment, the luminescent material comprised in second means (B) is selected from one or more compounds emitting light in the color green.

[0085] In one embodiment, said luminescent material comprised in said second means (B) is selected from one or more of the compounds listed in Table 2:

[0086] Table 2

Luminescent material	Emission colour	Emission maximum at [nm]
$(\text{Ba}, \text{Sr})_2\text{SiO}_4:\text{Eu}^{2+}$	green	505-550
$\text{Lu}_3(\text{Al}, \text{Ga}, \text{Sc})_5\text{O}_{12}:\text{Ce}^{3+}$	green	510-520
$\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$	green	530
$\text{SrSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$	green	540
$\text{SrGa}_2\text{S}_4:\text{Eu}^{2+}$	green	535
$\text{Y}_3\text{AlGa}_4\text{O}_{12}:\text{Ce}^{3+}$	green	504
ZnGa_2O_4	green	504
$\text{Ba}_2\text{MgSi}_2\text{O}_7:\text{Eu}^{2+}$	green	505
$\text{Lu}_3\text{Al}_2\text{Ga}_3\text{O}_{12}:\text{Ce}^{3+}$	green	510
$\text{CaY}_2\text{Al}_4\text{GeO}_{12}:\text{Ce}^{3+}$	green	510
ZnAl_2O_4	green	512
$\text{Y}_3\text{Al}_2\text{Ga}_3\text{O}_{12}:\text{Ce}^{3+}$	green	512
$\text{Lu}_3\text{ScAl}_4\text{O}_{12}:\text{Ce}^{3+}$	green	515
$\text{SrSi}_2\text{AlN}_3\text{O}_2:\text{Eu}^{2+}$	green	515

$\text{CaSc}_2\text{O}_4:\text{Ce}^{3+}$	green	520
$\text{Y}_3\text{Al}_3\text{Ga}_2\text{O}_{12}:\text{Ce}^{3+}$	green	523
$\text{Zn}_2\text{SiO}_4:\text{Mn}^{2+}$	green	525
$(\text{Sr}_{0.5}\text{Ba}_{0.5})_2\text{SiO}_4:\text{Eu}^{2+}$	green	525
$\text{Y}_3\text{Al}_4\text{GaO}_{12}:\text{Ce}^{3+}$	green	527
$\text{Zn}_2\text{GeO}_4:\text{Mn}^{2+}$	green	532

[0087] In another embodiment, the luminescent material comprised in said second means (B) is selected from one or more compounds emitting light in the color yellow.

[0088] In one embodiment, said luminescent material comprised in said second means (B) is selected from one or more of the compounds listed in Table 3:

[0089] Table 3

Luminescent material	Emission colour	Emission maximum at [nm]
$\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$	yellow	540
$\text{Tb}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$	yellow	560
$\text{CaSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$	yellow	560
$\text{La}_3\text{Si}_6\text{N}_{11}:\text{Ce}^{3+}$	yellow	565
$(\text{Y},\text{Gd})_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$	yellow	570

$\text{CaLu}_2\text{Al}_4\text{SiO}_{12}:\text{Ce}^{3+}$	yellow	555
$\text{Y}_2\text{GdAl}_5\text{O}_{12}:\text{Ce}^{3+}$	yellow	550
$\text{CaY}_2\text{Al}_4\text{SiO}_{12}:\text{Ce}^{3+}$	yellow	555
$\text{Mg}_3\text{Y}_2\text{Ge}_3\text{O}_{12}:\text{Ce}^{3+}$	yellow	555
$\text{YGd}_2\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$	yellow	565
$\text{Gd}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$	yellow	580

[0090] In another embodiment, the luminescent material comprised in said second means (B) is selected from one or more compounds emitting light in the color amber.

[0091] In one embodiment, said luminescent material comprised in said second means (B) is selected from one or more of the compounds listed in Table 4:

[0092] Table 4:

Luminescent material	Emission colour	Emission maximum at [nm]
$\text{SrLi}_2\text{SiO}_4:\text{Eu}^{2+}$	amber	580
$\text{Ba}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$	amber	585
$\text{Mg}_3\text{YGdGe}_3\text{O}_{12}:\text{Ce}^{3+}$	amber	575
$\text{La}_3\text{Si}_6\text{N}_{11}:\text{Ce}^{3+}$	amber	586

[0093] In another embodiment, the luminescent material comprised in said second means (B) is selected from one or more compounds emitting light in the color red.

[0094] In one embodiment, said luminescent material comprised in said second means (B) is selected from one or more of the compounds listed in Table 5:

[0095] Table 5

Luminescent material	Emission colour	Emission maximum at [nm]
$\text{Ca}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$	red	610
$\text{Sr}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$	red	620
$(\text{Ca},\text{Sr})\text{AlSiN}_3:\text{Eu}^{2+}$	red	620 - 650
$\text{CaS}:\text{Eu}^{2+}$	red	655
$\text{Mg}_4\text{GeFO}_{5.5}:\text{Mn}^{4+}$	red	660
$\text{LiEu}(\text{Mo},\text{W})_2\text{O}_8:\text{Eu}^{3+}$	red	615
$\text{Sr}[\text{Mg}_3\text{SiN}_4]:\text{Eu}^{2+}$	red	615
$\text{SrSi}_2\text{N}_2\text{O}_2:\text{Yb}^{2+}$	red	620
$\text{Sr}[\text{LiAl}_3\text{N}_4]:\text{Eu}^{2+}$	red	650
$\text{CaAlSiN}_3:\text{Eu}^{2+}$	red	650
$\text{Mg}_{14}\text{Ge}_5\text{O}_{24}:\text{Mn}^{4+}$	red	659
$\text{K}_2\text{Ge}_4\text{O}_9:\text{Mn}^{4+}$	red	664

$\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$	red	665
$\text{Li}_2\text{Ge}_4\text{O}_9:\text{Mn}^{4+}$	red	668
$\text{Na}_2\text{CaGe}_5\text{SiO}_{14}:\text{Mn}^{4+}$	red	670
$\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$	red	672
$\text{Ca}_2\text{GdNbO}_6:\text{Mn}^{4+}$	red	676
$\text{Ca}_2\text{YNbO}_6:\text{Mn}^{4+}$	red	682
$\text{Ca}_2\text{LuNbO}_6:\text{Mn}^{4+}$	red	683
$\text{Sr}_3\text{Al}_2\text{Ge}_4\text{O}_{14}:\text{Mn}^{4+}$	red	688
$\text{Ca}_2\text{ScNbO}_6:\text{Mn}^{4+}$	red	692
$\text{Ca}_2\text{LaNbO}_6:\text{Mn}^{4+}$	red	697
$\text{Y}_2\text{MgTiO}_6:\text{Mn}^{4+}$	red	698

[0096] In another embodiment, the luminescent material comprised in said second means (B) is selected from one or more compounds emitting light in the NIR range.

[0097] In one embodiment, said luminescent material comprised in said second means (B) is selected from one or more of the compounds listed in Table 6:

[0098] Table 6:

Luminescent material	Emission colour	Emission maximum at [nm]
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$\text{MgAl}_2\text{O}_4:\text{Cr}^{3+}$	NIR	682
$\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Cr}^{3+}$	NIR	688
$\text{GdMgAl}_{11}\text{O}_{19}:\text{Cr}^{3+}$	NIR	693
$\text{Al}_2\text{O}_3:\text{Cr}^{3+}$	NIR	693
$\text{BaMgAl}_{10}\text{O}_{17}:\text{Cr}^{3+}$	NIR	694
$\text{SrB}_4\text{O}_7:\text{Sm}^{2+}$	NIR	700
$\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Cr}^{3+}$	NIR	704
$\text{LiAl}_5\text{O}_8:\text{Cr}^{3+}$	NIR	716
$\text{GdAlO}_3:\text{Cr}^{3+}$	NIR	726
$\text{Y}_3\text{Ga}_5\text{O}_{12}:\text{Cr}^{3+}$	NIR	730
$\text{LaAlO}_3:\text{Cr}^{3+}$	NIR	734
$\text{Gd}_3\text{Ga}_5\text{O}_{12}:\text{Cr}^{3+}$	NIR	745
$\text{Mg}_2\text{SiO}_4:\text{Cr}^{3+}\text{Li}^+$	NIR	890
$\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$	NIR	880, 1060
$\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$	NIR	880, 1060
$\text{Gd}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$	NIR	880, 1060
$\text{Tb}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$	NIR	880, 1060

$\text{Ca}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$	NIR	900, 1100
$\text{Sr}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$	NIR	900, 1100
$\text{Ba}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$	NIR	900, 1100
$\text{LaScO}_3:\text{Mn}^{4+}$	NIR	703
$\text{La}_3\text{Mg}_2\text{TaO}_9:\text{Mn}^{4+}$	NIR	706
$\text{LaMgTiO}_6:\text{Mn}^{4+}$	NIR	709
$\text{MgLa}_2\text{GeO}_6:\text{Mn}^{4+}$	NIR	710
$\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Tb}^{3+}\text{Yb}^{3+}$	NIR	545, 970, 1030
$\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Tb}^{3+}\text{Yb}^{3+}$	NIR	545, 970, 1030
$\text{LaMgAl}_{11}\text{O}_{19}:\text{Mn}^{4+}$	NIR	731

[0099] In one embodiment, said luminescent material comprised in said second means (B) is selected from the group comprising or consisting of:

$\text{Sr}_4\text{Al}_{14}\text{O}_{25}:\text{Eu}^{2+}$, $\text{BaSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $(\text{Ba},\text{Sr})_2\text{SiO}_4:\text{Eu}^{2+}$, $\text{Lu}_3(\text{Al},\text{Ga},\text{Sc})_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Gd}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{SrSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $\text{SrGa}_2\text{S}_4:\text{Eu}^{2+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Tb}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{CaSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $\text{La}_3\text{Si}_6\text{N}_{11}:\text{Ce}^{3+}$, $(\text{Y},\text{Gd})_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{SrLi}_2\text{SiO}_4:\text{Eu}^{2+}$, $\text{Ba}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{Ca}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{Sr}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{LiSrAl}_3\text{N}_4:\text{Eu}^{2+}$, $(\text{Ca},\text{Sr})\text{AlSiN}_3:\text{Eu}^{2+}$, $\text{CaS}:\text{Eu}^{2+}$, $\text{Mg}_4\text{GeFO}_{5.5}:\text{Mn}^{4+}$, $\text{MgAl}_2\text{O}_4:\text{Cr}^{3+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Cr}^{3+}$, $\text{GdMgAl}_{11}\text{O}_{19}:\text{Cr}^{3+}$, $\text{Al}_2\text{O}_3:\text{Cr}^{3+}$, $\text{BaMgAl}_{10}\text{O}_{17}:\text{Cr}^{3+}$, $\text{SrB}_4\text{O}_7:\text{Sm}^{2+}$, $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Cr}^{3+}$, $\text{LiAl}_5\text{O}_8:\text{Cr}^{3+}$, $\text{GdAlO}_3:\text{Cr}^{3+}$, $\text{Y}_3\text{Ga}_5\text{O}_{12}:\text{Cr}^{3+}$, $\text{LaAlO}_3:\text{Cr}^{3+}$, $\text{Gd}_3\text{Ga}_5\text{O}_{12}:\text{Cr}^{3+}$, $\text{Mg}_2\text{SiO}_4:\text{Cr}^{3+}\text{Li}^+$, $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Gd}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Tb}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$,

$\text{Ca}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Sr}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Ba}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Ca}_2\text{Al}_2\text{SiO}_7:\text{Ce}^{3+}$,
 $\text{YBO}_3:\text{Ce}^{3+}$, $\text{CaY}_2\text{Al}_2\text{O}_7:\text{Ce}^{3+}$, $\text{CaAl}_2\text{Si}_2\text{O}_8:\text{Eu}^{2+}$, $\text{CaAl}_2\text{O}_4:\text{Eu}^{2+}$, $\text{CaMgSi}_2\text{O}_6:\text{Eu}^{2+}$,
 $\text{Y}_2\text{SiO}_5:\text{Ce}^{3+}$, $\text{Sr}_2\text{ZnSi}_2\text{O}_7:\text{Eu}^{2+}$, $\text{Sr}_3\text{Al}_{10}\text{SiO}_{20}:\text{Eu}^{2+}$, $\text{Sr}_2\text{MgSi}_2\text{O}_7:\text{Eu}^{2+}$, $\text{SrAl}_4\text{O}_7:\text{Eu}^{2+}$,
 $\text{Sr}_3\text{MgSi}_2\text{O}_8:\text{Eu}^{2+}$, $\text{ZnO}:\text{Zn}$, $\text{Ba}(\text{Zr},\text{Hf})\text{Si}_3\text{O}_9:\text{Eu}^{2+}$, $\text{SrSiAl}_2\text{O}_3\text{N}:\text{Eu}^{2+}$, Mg_2SnO_4 ,
 $\text{Ca}_9\text{Y}(\text{PO}_4)_7$, $\text{Y}_3\text{AlGa}_4\text{O}_{12}:\text{Ce}^{3+}$, ZnGa_2O_4 , $\text{Ba}_2\text{MgSi}_2\text{O}_7:\text{Eu}^{2+}$, $\text{Lu}_3\text{Al}_2\text{Ga}_3\text{O}_{12}:\text{Ce}^{3+}$,
 $\text{CaY}_2\text{Al}_4\text{GeO}_{12}:\text{Ce}^{3+}$, $\text{CaY}_2\text{Al}_4\text{GeO}_{12}:\text{Ce}^{3+}$, ZnAl_2O_4 , $\text{Y}_3\text{Al}_2\text{Ga}_3\text{O}_{12}:\text{Ce}^{3+}$,
 $\text{Lu}_3\text{ScAl}_4\text{O}_{12}:\text{Ce}^{3+}$, $\text{SrSi}_2\text{AlN}_3\text{O}_2:\text{Eu}^{3+}$, $\text{CaSc}_2\text{O}_4:\text{Ce}^{3+}$, $\text{Y}_3\text{Al}_3\text{Ga}_2\text{O}_{12}:\text{Ce}^{3+}$, $\text{Zn}_2\text{SiO}_4:\text{Mn}^{2+}$,
 $(\text{Sr}_{0.5}\text{Ba}_{0.5})_2\text{SiO}_4:\text{Eu}^{2+}$, $\text{Y}_3\text{Al}_4\text{GaO}_{12}:\text{Ce}^{3+}$, $\text{Zn}_2\text{GeO}_4:\text{Mn}^{2+}$, $\text{CaLu}_2\text{Al}_4\text{SiO}_{12}:\text{Ce}^{3+}$,
 $\text{Y}_2\text{GdAl}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{CaY}_2\text{Al}_4\text{SiO}_{12}:\text{Ce}^{3+}$, $\text{Mg}_3\text{Y}_2\text{Ge}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{YGd}_2\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$,
 $\text{Mg}_3\text{YGdGe}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{Mg}_3\text{Y}_{0.25}\text{Gd}_{0.75}\text{Ge}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{Ba}_2\text{Mg}(\text{BO}_3)_2:\text{Yb}^{2+}$,
 $\text{Mg}_3\text{Gd}_2\text{Ge}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{Mg}_3\text{Gd}_2\text{Ge}_2\text{SiO}_{12}:\text{Ce}^{3+}$, $\text{LiEu}(\text{Mo},\text{W})_2\text{O}_8:\text{Eu}^{3+}$, $\text{Sr}[\text{Mg}_3\text{SiN}_4]:\text{Eu}^{2+}$,
 $\text{SrSi}_2\text{N}_2\text{O}_2:\text{Yb}^{2+}$, $\text{Sr}[\text{LiAl}_3\text{N}_4]:\text{Eu}^{2+}$, $\text{Mg}_{14}\text{Ge}_5\text{O}_{24}:\text{Mn}^{4+}$, $\text{K}_2\text{Ge}_4\text{O}_9:\text{Mn}^{4+}$, $\text{Li}_2\text{Ge}_4\text{O}_9:\text{Mn}^{4+}$,
 $\text{Na}_2\text{CaGe}_5\text{SiO}_{14}:\text{Mn}^{4+}$, $\text{Ca}_2\text{GdNbO}_6:\text{Mn}^{4+}$, $\text{Ca}_2\text{YNbO}_6:\text{Mn}^{4+}$, $\text{Ca}_2\text{LuNbO}_6:\text{Mn}^{4+}$,
 $\text{Sr}_3\text{Al}_2\text{Ge}_4\text{O}_{14}:\text{Mn}^{4+}$, $\text{Ca}_2\text{ScNbO}_6:\text{Mn}^{4+}$, $\text{Ca}_2\text{LaNbO}_6:\text{Mn}^{4+}$, $\text{Y}_2\text{MgTiO}_6:\text{Mn}^{4+}$,
 $\text{LaScO}_3:\text{Mn}^{4+}$, $\text{La}_3\text{Mg}_2\text{TaO}_9:\text{Mn}^{4+}$, $\text{LaMgTiO}_6:\text{Mn}^{4+}$, $\text{MgLa}_2\text{GeO}_6:\text{Mn}^{4+}$,
 $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Tb}^{3+}\text{Yb}^{3+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Tb}^{3+}\text{Yb}^{3+}$, $\text{LaMgAl}_{11}\text{O}_{19}:\text{Mn}^{4+}$, or a mixture of two or more thereof.

[00100] According to the invention, said luminescent material may be an organic compound, i.e. a luminescent organic dye, or a material comprising a luminescent organic dye, or a quantum dot or a quantum dot-comprising material.

[00101] Exemplary dyes include the daylight fluorescent-type dyes that belong to the dye families known as rhodamines, fluoresceins, coumarins, naphthalimides, xanthenes including benzoxanthenes, oxazines such as phenoxazines, oxazole such as benzoxazoles, perylenes, pyrenes, acridines, anthracenes, triphenylenes, phthalocyanines, porphyrines, stilbenes, carbocyanines, quinolones, thiazoles such as benzothiazoles, furans, metal complexes of said dyes such as Pt or Ir complexes, or a combination comprising at least two or more thereof.

[00102] In one embodiment, suitable luminescent organic dyes may be selected from the group comprising or consisting of the following dyes: a perylene dye, a triphenylene dye, a naphthalimide dye, a xanthene dye, a phenoxazine dye, an acridine dye, an anthracene dye, a phenazine dye, or a coumarin dye, or two or more thereof.

[00103] The term "*perylene dye*" etc. means that the dye comprises a perylene moiety.

[00104] Examples include luminescent dyes such as 7-amino-4-methylcoumarin; 3-(2'-benzothiazolyl)-7-diethylaminocoumarin; 2-(4-biphenyl)-5-(4-t-butylphenyl)-1,3,4-oxadiazole; 2,5-bis-(4-biphenyl)-oxazole; 2,2'-dimethyl-p-quaterphenyl; 2,2-dimethyl-p-terphenyl; 3,5,3''', 5'''-tetra-t-butyl-p-quinquephenyl; 2,5-diphenylfuran; 2,5-diphenyloxazole; 4,4'-diphenylstilbene; 4-dicyanomethylene-2-methyl-6-(p-dimethylaminostyryl)-4H-pyran; 1,1'-diethyl-2,2'-carbocyanine iodide; 3,3'-diethyl-4,4',5,5'-dibenzothiatricarbocyanine iodide; 7-dimethylamino-1-methyl-4-methoxy-8-azaquinolone-2; 7-dimethylamino-4-methylquinolone-2; 2-(4-(4-dimethylaminophenyl)-1,3-butadienyl)-3-ethylbenzothiazolium perchlorate; 3-diethylamino-7-diethyliminophenoxazonium perchlorate; 2-(1-naphthyl)-5-phenyloxazole; 2,2'-p-phenylene-bis(5-phenyloxazole); rhodamine 700; rhodamine 800; pyrene; chrysene; rubrene; coronene, or the like; perylene dyes such as those based on imido derivatives of perylene tetracarboxylic acid; or combinations comprising at least one of the foregoing dyes. Suppliers of fluorescent colorants include Radiant Color Company (Richmond, Calif.), Day-Glo Color Corp. (Cleveland, Ohio), Sun Chemical Co. (Cincinnati, Ohio), Sinlohi Co. Ltd. (Tokyo, Japan), Swada (London, England), Mikuni Color Works Ltd. (Himeji, Japan), Matsui International Co, Inc (Japan), Nippon Keiko Color Company (Japan). Specifically useful fluorescent dyes include those available under the following tradenames: Diaresin® dyes from Mitsubishi Chemical (Japan); Lumogen® dyes from BASF (Germany), Irgalite® and

Maxilon® dyes from Ciba Specialty Chemicals (Germany), Macrolex® dyes from Lanxess (Germany), and Hostasol® dyes from Clariant. Typical commercially available fluorescent dyes of the above types include amino phthalate dyes such as Rhodamine BDC (C.I. 45,170), Rhodamine 6GDN extra (C.I. 45,160; Red 480), Rhodamine F5G (Red 482), Rhodamine FB (Red 540), and Rhodamine F3B (C.I. 45,175); naphthalimide derivatives such as Lumogen® F Blue 650; perylene derivatives such as Lumogen® F Red 300; Lumogen® F Red 305; Lumogen® F Yellow 083; Lumogen® F Violet 570; Lumogen® F Green 850; Macrolex® Fluorescent Yellow 10GN (C.I. Solvent Yellow 160:1); Macrolex® Red G; Irgalite® Violet M, Maxilon® Brilliant Flavine 10GFF, Maxilon® Black FBL-01, Maxilon® Black RM-01, Maxilon® Blue 5G, Maxilon® Blue 5G-01, Maxilon® Blue GRL/Pearl, Maxilon® Blue GRL Granulated, Maxilon® Blue GRL E, Maxilon® Blue M-G, Maxilon® Blue TRL Liquid, Maxilon® Golden Yellow GL Pearls, Maxilon® Navy FRL-02, Maxilon® Red GRL-01 Pearl, Maxilon® Red GRL-E, Maxilon® Red GRL Pearls, Maxilon® Red M-4GL, Maxilon® Yellow M-3RL, and Maxilon® Yellow M-4GL; Hostasol® Red 5B (Vat Red 41), Hostasol® Red GG (Solvent Orange 63), and Hostasol® Yellow 3G (Solvent Yellow 98); Fluorescent yellow F6PN and Yellow Y toner; Fluorescent Red 66; fluorescein; and 9-aminoacridine. A combination comprising at least one of the foregoing fluorescent dyes may be used. In an exemplary embodiment, fluorescent dyes useful herein include Lumogen® F Blue 650, Lumogen® Red 305, and Macrolex® Fluorescent Yellow 10GN. It will be understood that numerous fluorescent dyes are available commercially and are useful herein, and that therefore the foregoing list of fluorescent dyes should be considered exemplary and not limiting to the dyes disclosed hereinabove.

[00105] In general, said luminescent material, i.e. that luminescent organic dye or said quantum dot comprised in the second means (B) converts said light to a light having a longer wavelength than the exciting light emitted from the at least one OLED or LED comprised in the first means (A).

[00106] In one embodiment, the luminescent material comprised in the second means (B) converts said emitted light to violet, green or yellow or amber or rose or red light or light in the NIR region (Near Infrared).

[00107] Exemplary luminescent organic dyes and the colour of the luminesced light are listed in the following table 7:

[00108] Table 7

Luminescent material (luminescent organic dye)	Emission colour	Emission maximum at [nm]
9,10-diphenylanthracene (CAS No.1499-10-1)	violet	410
Lumogen® F Violet 570 (perylene dye; Color Index: fluorescence brightener 331)	violet	413
2-chloro-9,10-diphenylanthracene	blue-green	516
Lumogen® F Green 850 (perylene dye)	green	520
Fluoresceine	green	545

(xanthene dye)		
Eosine Y (xanthene dye)	yellow	540
Lumogen® F Yellow ED206 (perylene dye)	yellow	560
Lumogen® F Yellow 170 (perylene dye)	yellow	550, 570
Lumogen® F Orange 240 (CAS no. 82953-57-9) (perylene dye)	orange	540, 580
Lumogen® F Rose 285	rose	595
Eosine B (xanthene dye)	red	570
Rhodamine B (xanthene dye)	red	573
Lumogen® F Red 305 (perylene dye; CAS No.	red	615

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[00109] By means of said luminescent material comprised in said second means (B), a targeted colour light may be generated and which is adjusted such to be suitable for the intended use.

[00110] In one embodiment, the colour may be further adjusted by using a suitable filter or suitable filters.

[00111] In one embodiment, the use of one or more color filters is not necessary. This is advantageous in view of the achievable efficiency of the emitted light.

[00112] Said luminescent material comprised in said second means (B) is comprised in an organic material.

[00113] In one embodiment, said organic material is a solid polymeric material in which the luminescent material (B) is incorporated. Suitable polymers may be silicone or epoxy resins, acrylates such as poly(methylmethacrylates) (PMMA), polycarbonate (PC) or polystyrenes (PS).

[00114] In one embodiment, said luminescent organic dye is not dissolvable in said solid polymeric material but is rather dispersed therein.

[00115] In one embodiment, said luminescent organic material incorporated in said polymeric material is provided in the form of nanobeads. In one embodiment, the particle size of the nanobeads in terms of D_{90} is in the range of from 2 to 200 nm, the particle size being measured using light diffraction.

[00116] In one embodiment, as polymeric material the same materials may be used as used for the optical waveguide comprised in the third means (C) as set out in the respective section below.

[00117] In another embodiment, said organic material may be a semisolid polymeric material such as a gel in which the luminescent material comprised in the second means (B) is incorporated.

[00118] In one embodiment, suitable gels are selected out of acrylates, cellulose ethers, xanthan, and carbomers, or mixtures of two or more thereof.

[00119] In one embodiment, the refractive index of the polymeric material, e.g. in the form of a gel, ranges from 1.0 - 1.5, and the refractive index of the luminescent material ranges from 1.5 - 2.5, preferably 1.5 - 1.8.

[00120] In one embodiment, upon application, said second means (B) is configured to be adapted to a certain shape of a target of a subject to be irradiated, e.g. a portion of the arm or leg or shoulder of a subject.

[00121] Thus, said second means (B) may also include the light emitting portion (Z).

[00122] Coating materials for the luminescent material (E)

[00123] The used luminescent material comprised in the second means (B) may be used in a coated form or an uncoated form.

[00124] The term “coated” encompasses the term “encapsulated”. Suitable coating or encapsulating processes are known in the art.

[00125] A coating may increase the durability of the luminescent material comprised in the second means (B) or the stability of the emitted light thereof.

[00126] In one embodiment, said at least one luminescent material comprised in the second means (B) is coated with at least one coating material (E) selected from the group comprising or consisting of: SiO_2 , Si_3N_4 , AlN , Al_2O_3 , MgO , MgAl_2O_4 , or phosphates $(\text{RE})\text{PO}_4$, $(\text{EA})_2\text{P}_2\text{O}_7$, or $(\text{EA})_3(\text{PO}_4)_2$, wherein $\text{RE} = \text{Sc}$, Y , La , Gd , or Lu , and $\text{EA} = \text{Mg}$, Ca , Sr , or Ba , or a mixture of two or more thereof.

[00127] In one embodiment, the concentration of the luminescent material comprised in the second means (B), at the place, where said light emitted by said at least one OLED or LED comprised in said first means (A), is guided via said optical waveguide comprised in said third means (C) to said at least one luminescent material comprised in said second means (B), is lower than in a place adjacent thereto.

[00128] In such embodiment, the luminescent material comprised in said second means (B) is distributed such to form one or more concentration gradients.

[00129] This may have the advantage that in one embodiment the light emitted by said at least one second means may be distributed as homogeneously as possible across the area of said second means (B) that is intended for the use in the therapeutic application.

[00130] Optical elements for increasing light output (F)

[00131] In a further embodiment, said at least one luminescent material comprised in the second means (B) comprises at least one optical element (F) which is configured to increase the efficiency of the light output of said at least one luminescent material comprised in the second means (B) when said at least one luminescent material converts light emitted from said at least one OLED or LED comprised in the first means (A).

[00132] In one embodiment, said at least one optical element (F) which is configured to increase the efficiency of the light output of said at least one luminescent material

when said at least one luminescent material converts light emitted from said at least one OLED or LED, is selected from the group comprising or consisting of: lens, microlens, reflector, metal film, metallic nanoparticles, glass, or acrylic glass such as an acrylic glass, or a combination of two or more thereof.

[00133] In one embodiment, said at least one optical element (F), which is configured to increase the efficiency of the light output of said at least one luminescent material, comprises or consists of a light distributing structure that distributes the light emitted by and received from said first means (A) comprising at least one OLED or LED across an area of the second means (B) comprising said at least one luminescent material. Preferably, said area covers at least half of the full area of the portion of the second means (B) comprising said at least one luminescent material. More preferably, said area covers at least 80 % of said full area. In this advantageous way said at least one luminescent material in the second means (B) may be excited with a specific pattern as desired by the skilled person. In particular, the light received from said first means (A) comprising at least one OLED or LED may be distributed homogeneously over a portion of the second means (B), which comprises said at least one luminescent material.

[00134] In one embodiment, the light received from said first means (A) comprising at least one OLED or LED may be distributed with a pattern, particularly a light intensity pattern, which is at least essentially equal to that density distribution of said at least one luminescent material. An advantage of a light distribution matching the distribution of said at least one luminescent material may arise from the fact, that over-excitation and/or under-excitation of said at least one luminescent material may be reduced, thereby increasing the efficiency of the light output of said at least one luminescent material.

[00135] In one embodiment, said light distributing structure may comprise or consist of one or more optical waveguides, in particular in the form of optical fibers. Preferably, one or more of the optical fibers of said light distributing structure are bent such that a portion of the light guided through said optical fibers escapes through the sidewalls of said optical fibers at the bends. Alternatively or additionally and also preferably, such an optical fiber of said light distributing structure comprises a side glow fiber and/or a portion that is configured to allow a portion of the light guided through said fiber to escape through the sidewalls of said fiber, even when this fiber is not bent. In a preferred embodiment, an optical fibers allowing a portion of the guided light to escape through the sidewalls comprises one end for receiving the light emitted by said first means (A) comprising at least one OLED or LED. Moreover, this optical fiber is preferably configured, to have an increasing relative amount of light escaping through the sidewalls, the further the light has travelled through this fiber from said and for receiving the light emitted by said at least one OLED or LED. In this beneficial way, the absolute amount of light escaping through a section of the sidewalls may at least essentially be constant, because the further the light travels through said fiber the more it is attenuated, e.g. by absorption and/or a portion of the light escaping through the sidewalls, and therefore a higher relative amount has to escape through the sidewalls to result in an at least essentially constant amount of slide escaping through the sidewalls along said fiber.

[00136] In one embodiment, said light distributing structure may comprise at least one optical fiber. Said optical fiber comprises one end portion for receiving the light emitted by said at least one OLED or LED comprised in the first means (A). For distributing the received light said optical fiber meanders across an area of the second means (B) comprising said at least one luminescent material. Preferably, the radii of the bends of the meander decrease the further the respective bend is distant from said end portion for receiving the light, wherein the distance between the respective bend and said end portion for receiving the light is a respective to the

traveling distance the light guided through said optical fiber. Thereby, in particular, a decreasing light intensity along said optical fiber may be balanced with regard to the light escaping through the bends of the meander. In one embodiment, said at least one optical element (F), which is configured to increase the efficiency of the light output of said at least one luminescent material, comprises or consists of a reflector device. Said reflector device is arranged to at least partially enclose an area of the second means (B) comprising said at least one luminescent material. Also said reflector device is arranged and/or configured to permit light being emitted through said light emitting surface of the second means (B) and to prevent light being emitted from at least one other surface of the second means (B) by reflecting the light. In this beneficial way, the efficiency of the light output may be increased.

[00137] Preferably, said reflector device comprises a first and/or a second reflector surface each facing a side of said area of the second means (B) comprising said at least one luminescent material. Also preferably, said first and second reflector surface are opposite to each other, wherein at least a portion of said area comprising said at least one luminescent material is arranged in between said first and second reflector surface. Preferably, said first and/or said second reflector surface are reflective for light with wavelengths which said at least one OLED or LED comprised in the first means (A) emits. Preferably, said first reflector surface is opaque for light with wavelengths which said at least one luminescent material emits. Preferably, said first reflector surface is arranged at said light emitting surface of the second means (B), in particular such that light emitted by said at least one luminescent material may pass through said first reflector surface and thus said light emitting surface, while light emitted by said at least one OLED or LED is reflected back to said at least one luminescent material.

[00138] Cover means (G)

[00139] In one embodiment, said second means (B) comprises cover means (G), wherein said second means (B) has a light emitting surface, and the cover means (G) prevents light being emitted from other surfaces of the second means (B) than said light emitting surface.

[00140] Such means may be construed in the form of reflectors or other materials such as textile tissue, which at least partially cover the second means.

[00141] Such means cover at least a part of said second means (B) such to force light to be emitted from the light emitting portion (Z) of the medical patch.

[00142] Optical waveguide comprised in third means (C)

[00143] The irradiation device according to the invention comprises an optical waveguide which is comprised in said third means (C), and which is configured to guide said light emitted by said at least one OLED or LED comprised in the first means (A) to said at least one luminescent material comprised in the second means (B).

[00144] The term “*optical waveguide*” which is synonymously used with the terms “*waveguide*” or “*lightguide*”, encompasses any physical structure that guides electromagnetic waves in the optical spectrum.

[00145] Common types of optical waveguides include optical fiber and rectangular waveguides.

[00146] In one embodiment, the optical waveguide comprised in said third means (C) can be in the form of a planar, strip, or fiber waveguide.

[00147] In one embodiment, said optical waveguide comprised in said third means (C) is a two-dimensional waveguide such as a strip waveguide or a rib waveguide as is known in the field of optical waveguides.

[00148] In one embodiment, said waveguide comprised in said third means (C) is an optical fiber as is known in the art.

[00149] The term “*waveguide*” and the term “*optical fiber*” encompass a circular cross-section dielectric waveguide consisting of a dielectric material surrounded by another dielectric material with a lower refractive index. Accordingly, light being guided in said waveguide or optical fiber is subjected to a total internal reflection within the waveguide or optical fiber. In view of this, a waveguide is distinct e.g. from a layer of e.g. a polymeric material which allows light to transmit said polymeric material.

[00150] In one embodiment, said optical fiber is made from silica glass or plastic optical fiber.

[00151] In one embodiment, said plastic optical fiber is made from a poly(meth)acrylate or a polystyrene as the core material, and fluorinated polymers or silicone are the cladding material. Other materials such as perfluorinated polymers such as poly(perfluoro butenyl vinyl ether) may be used, too. Poly(methylmethacrylate) (PMMA) or polystyrene may be used as fiber core.

[00152] In one embodiment, said optical fiber comprises or consists of a large core optical fiber. A benefit of such a large core optical fiber in the application of the present invention may arise from the fact, that large core optical fibers typically can transfer a higher amount of light energy and/or intensity. Another benefit may be that coupling large core fibers to each other or to a light source or a light sink typically is technically easier and less error-prone than coupling with optical fibers with smaller cores, e.g. single mode fibers.

[00153] In one embodiment, said optical fiber comprises or consists of a hollow optical fiber. A benefit from said hollow optical fiber may arise from the fact that the

interior of such fiber can be filled with a suitable gas, thereby further improving the transmission of light with relative short wavelength such as UV light. Hollow optical fibers are known in the art.

[00154] In one embodiment, said optical fiber comprises or consists of a photonic-crystal fiber. In turn, the use of photonic-crystal fiber may improve the transmission of light with relative short wavelength emitted by said OLED or LED comprised in said first means (A). Photonic-crystal fibers are known in the art.

[00155] In one embodiment, said optical fiber comprises or consists of a hollow photonic-crystal fiber further improving light transmission. Hollow photonic-crystal fibers are known in the art.

[00156] Hollow optical fibers, photonic-crystal fibers and hollow photonic-crystal fibers may be useful for increasing light output compared to waveguides having a core.

[00157] Preferably, said optical fiber is a broadband optical fiber, which permits the transmission of light of a broad spectrum of wavelengths, e.g. light with wavelengths ranging from 200 nm to 2,000 nm or a sub range such as 400 nm to 800 nm.

[00158] Alternatively and also preferred, said optical fiber is tuned to permit particularly the transmission of light with wavelengths that is emitted by said at least one OLED or LED comprised in the first means (A). Thereby, the transmission of light with these wavelengths may be optimized. In other benefit may arise from the fact, that light with other wavelengths will be attenuated, and thus said optical fiber additionally functions as a filter, which filters out light with other wavelengths. Thereby, light with undesired wavelengths, e.g. in particular infrared light or UV light, which does not excite said at least one luminescent material and/or is detrimental for a treated person, may be filtered out.

[00159] In one embodiment, two or more different waveguides may be used.

[00160] In one embodiment, said waveguide comprised in said third means (C) has a planar structure, wherein said luminescent material comprised in said second means (B) is arranged on said planar waveguide comprised in said third means (C).

[00161] In one embodiment, at least a part of said optical waveguide comprised in said third means (C) has a planar structure and said at least one luminescent material comprised in said second means (B) is arranged on said planar structure, and at least a further part of said optical waveguide comprised in said third means (C) is in the form of a fiber and connects the at least one OLED or LED (A) to said planar structure.

[00162] By means of such arrangement, it is e.g. possible to provide said OLED or LED comprised in said first means (A) and said luminescent material comprised in said second means (B) at different locations, i.e. locations that are spatially separated from one another, e.g. which are spaced apart from one another. This is particularly advantages in view of a thermal decoupling of heat generated by the OLED or LED.

[00163] E.g., in one embodiment, only said planar structure and said at least one luminescent material comprised in said second means (B) are in contact with skin or close to the skin, and the at least one OLED or LED comprised in said first means (A) may be placed at a location which is spaced apart therefrom.

[00164] In one preferred embodiment, said waveguide comprised in said third means (C), preferably in the form of a fiber, respectively the third means (C) comprising said waveguide, is detachable from said at least one OLED or LED comprised in said first means (A) or from said second means (B), e.g. detachable from said planar structure. By means of such arrangement, it is e.g. possible to replace said at least one luminescent material comprised in said second means (B) (or the respective medical patch in which said luminescent material is incorporated) intended for a

particular use by another luminescent material comprised in said second means (B) (or screen) intended for another particular use. This avoids the need of providing a complete set of first means (A) and second means (B) when the use changes. This is advantageous in view of economic aspects.

[00165] In one preferred embodiment, said waveguide comprised in said third means (C) is connectable to said first means (A) comprising at least one OLED or LED and/or to said second means (B) by a connector system. Preferably, said connector system comprises a plug and a socket, wherein the plug or the socket is physically connected to said waveguide, or the plug and the socket are physically connected to said first means (A) or said second means (B), respectively. In this beneficial way, said waveguide may be, in particular repeatedly, detached from said first means (A) comprising at least OLED or LED or said second means (B).

[00166] In one preferred embodiment, said second means (B) comprises a receiving portion for receiving an end portion of said waveguide, which is configured to, preferably repeatedly, receives and physically connects to said end portion of said waveguide. Preferably, said receiving section comprises a cavity configured to contain an optical gel, wherein said optical gel forms an optical contact between said waveguide and said second means (B), in particular said at least one luminescent material. Preferably, the optical gel has an optical index which enables light from the end portion of the waveguide to be emitted, at least essentially without reflection back into the waveguide. In particular, the optical index of such an optical gel may be adjusted by an concentrations of ions or molecules dissolved in said optical gel. Optical gels are known in the art.

[00167] In particular, said optical gel is transparent for light with wavelengths emitted by said at least one OLED or LED, and/or with wavelengths for exciting said at least one luminescent material, and/or is filtering light with other wavelengths. In particular,

said optical index refers to the refractive index, the dispersion or a combination thereof.

[00168] In another preferred embodiment, said waveguide is in form of one or more optical fibers and the second means (B) comprises one or more additional optical fibers. At least one of said optical fibers is connected to one of said additional optical fibers by fusion splicing. In this beneficial way, said second means (B) may be connected to said waveguide without the need of a connector system, e.g. a plug and a socket, thereby, in particular, reducing the weight and/or simplifying the production of the second means (B) and/or increasing the wear comfort by avoiding hard object near or at the second means (B). Correspondingly, said waveguide may also be connected in this way to said first means (A) comprising at least one OLED or LED. Moreover, for detaching said waveguide, i.e. the optical fibers of said waveguide, may be cleaved. For a new connection to said second means (B) or said first means (A) comprising at least one OLED or LED, said waveguide may be fusion spliced again.

[00169] The inclusion of an optical waveguide comprised in third means (C) is beneficial for decoupling the heat emitted from said OLED or LED from the luminescent material. This allows that e.g. only a light therapy or phototherapy, optionally including a cosmetic application, may be performed without applying heat.

[00170] The optical waveguide may also comprise an optical filter to remove radiation of undesired spectral ranges.

[00171] In one embodiment, said luminescent material comprised in said second means (B) is located on the waveguide comprised in said third means (C).

[00172] In one embodiment, said luminescent material comprised in second means (B) is provided in a screen which in turn is located on an optical waveguide comprised in third means (C).

[00173] In another embodiment, said luminescent material comprised in second means (B) is incorporated in the optical waveguide comprised in third means (C).

[00174] According to the invention, said first means (A) and said second means (B) are not in physical contact with one another.

[00175] The term "*not in physical contact with one another*" signifies that the first means (A) and the second means (B) are spatially separated from one another, and do not touch one another.

[00176] According to the invention, said third means (C) connects the first means (A) to the second means (B), and thus also connects the second means (B) to the first means (A).

[00177] In this regard, the term "*connects*" used in the term "*wherein said third means (C) connects the first means (A) to the second means (B)*" encompasses an optical connection, in which said waveguide is not necessarily in physical contact with the second means (B), as well as a physical contact.

[00178] The waveguide comprised in third means (C), and thus also third means (C) which physically separates first means (A) and second means (B) from one another is characterized by a certain length. In one embodiment, the length is at least 10 cm or at least 50 cm, or at least 100 cm, or at least 100 cm, or at least 150 cm, or at least 200cm.

[00179] The upper limit of the length is not particularly limited. In one embodiment, the upper limit of the length is in the range of from 300 to 500 cm.

[00180] Therapeutic application

[00181] According to the invention, the irradiation device defined therein is suitable for use in a therapeutic application, wherein the therapeutic application comprises or consists of the irradiation of a skin, a tissue or a muscle, or in a combination of two or three thereof, of a subject.

[00182] Accordingly, a skin and a tissue, or a skin or a muscle, or a tissue and a muscle, or a skin and a tissue and a muscle may be irradiated.

[00183] In one embodiment, said therapeutic application is selected from the group consisting of: light therapy, photodynamic therapy, or heat therapy, or a combination of two or three thereof. Said terms have a well-accepted meaning in the medical field.

[00184] Light therapy

[00185] In one embodiment, the medical patch or medical irradiation device according to the invention is suitable for use in light therapy. The term "*light therapy*" encompasses the exposure of a person in need thereof to the light emitted from the luminescent material of the device according to the invention. This light is administered for a prescribed amount of time and, in some cases, at a specific time of day, to a person in need thereof.

[00186] The term "*light therapy*" is synonymously used with terms such as "*phototherapy*" or "*heliotherapy*".

[00187] In one embodiment, the medical patch or medical irradiation device or the light therapy is suitable for use in the treatment of skin disorders.

[00188] In one embodiment, skin disorders are selected from psoriasis, vitiligo, acne vulgaris, and skin cancer, reduction of inflammatory skin reactions, treatment of atopic dermatitis, or treatment of pruritus.

[00189] In one embodiment, skin disorders are selected from eczema, atopic dermatitis, polymorphous light eruption or lichen planus.

[00190] In a further embodiment, the medical patch or medical irradiation device or the light therapy is suitable for use in wound healing. In one embodiment, the luminescent material comprised in the second means (B) of the irradiation device is selected such that it emits light in the wavelength range of from 1,400 to 2,000 nm when used in light therapy when being excited by said at least one OLED or LED comprised in said first means (A).

[00191] In a further embodiment, the medical patch or medical irradiation device or the light therapy is suitable for use in the treatment of mood and sleep related conditions.

[00192] In one embodiment, mood and sleep related conditions are selected from seasonal affective disorders, non-seasonal depression and other psychiatric disturbances, including major depressive disorder, bipolar disorder and postpartum depression, and circadian rhythm sleep phase disorders.

[00193] In a further embodiment, the irradiation device or the light therapy is suitable for use in the treatment of individuals on shift work, and for jet lag.

[00194] In a further embodiment, the medical patch or medical irradiation device or the light therapy provided by said irradiation device is suitable for use in the treatment of natal jaundice. In one embodiment, the fluorescent material of the irradiation device is selected such that it emits light in the wavelength range of about 450 nm (emission maximum) when used in the treatment of natal jaundice.

[00195] Photodynamic therapy

[00196] In one embodiment, the medical patch or medical irradiation device is suitable for use in photodynamic therapy. The term "*photodynamic therapy*" encompasses the exposure of a person in need thereof to nontoxic light-sensitive compounds that are exposed selectively to light, whereupon they become toxic to targeted malignant and other diseased cells.

[00197] The term "*photodynamic therapy*" is synonymously used with the term "*photochemotherapy*".

[00198] In one embodiment, the photodynamic therapy involves three key compounds, i.e. a photosensitizer, the irradiation device, and tissue oxygen. The combination of these three components leads to the chemical destruction of any tissues which have either selectively taken up the photosensitizer or have been locally exposed to light. The wavelength of the light source needs to be appropriate for exciting the photosensitizer to produce reactive oxygen species. These reactive oxygen species generated through photodynamic therapy are free radicals (Type I photodynamic therapy) generated through electron abstraction or transfer from a substrate molecule and highly reactive state of oxygen known as singlet oxygen (Type II photodynamic therapy). Suitable photosensitizers are known in the art such as porphyrins, chlorophylls, dyes, aminolevulinic acid, silicon phthalocyanine, m-tetrahydroxyphenylchlorin, and mono-L-aspartyl chlorine e6.

[00199] In one embodiment, the luminescent material comprised in said second means (B) is selected such that it emits light in the wavelength range of red light to near infrared light (NIR) when being excited by said at least one OLED or LED comprised in said first means (A).

[00200] In one embodiment, the medical patch or medical irradiation device or the photodynamic therapy is suitable to be used for treating malignant cancer.

[00201] In one embodiment, the medical patch or medical irradiation device or the photodynamic therapy provided by said patch or irradiation device is suitable to be used to kill microbial cells, including bacteria, fungi and viruses.

[00202] In one embodiment, the medical patch or medical irradiation device or the photodynamic therapy provided by said patch or irradiation device is suitable to be used to treat acne.

[00203] In one embodiment, the medical patch or medical irradiation device or the photodynamic therapy is suitable to be used to treat wet age-related macular degeneration.

[00204] Heat therapy

[00205] In one embodiment, the medical patch or medical irradiation device is suitable to be used in heat therapy. The term "*heat therapy*" encompasses the application of heat to the body of a subject for pain relief and health. The term is synonymously used with the term "*thermotherapy*".

[00206] In one embodiment, the luminescent material comprised in said second means (B) of the irradiation device is selected such that it emits light in the wavelength range of from 800 to 2,000 nm when used in heat therapy and when being excited by said at least one OLED or LED comprised in said first means (A).

[00207] Heat is typically applied by subjecting the relevant body part of a subject to the irradiation device.

[00208] In one embodiment, the medical patch or medical irradiation device or the heat therapy provided by said patch or irradiation device is suitable to be used for the treatment of arthritis, stiff muscles, injuries to the deep tissue of the skin, and rheumatoid arthritis.

[00209] In one embodiment, the medical patch or medical irradiation device or the heat therapy provided by said patch or irradiation device is suitable to be used for rehabilitation purposes.

[00210] In one embodiment, the medical patch or medical irradiation device or the heat therapy provided by patch or said irradiation device is suitable to be used for increasing the extensibility of collagen tissue, decreasing joint stiffness, reducing pain, relieving muscle spasms, myalgia, fibromyalgia, contracture, and bursitis, reducing inflammation, edema, and aids in the post-acute phase of healing; and increasing blood flow.

[00211] In one embodiment, the medical patch or medical irradiation device or the heat therapy is suitable to be used for the treatment of infection and cancers.

[00212] In one embodiment, the medical patch or medical irradiation device or the heat therapy provided by said irradiation device is suitable to be used for the treatment of headaches and migraines.

[00213] Specific therapeutic applications

[00214] In one embodiment, hyperpigmentation, e.g. melasma, age spots, freckles, darker skin types, and / or general pigmentation problems are treated.

[00215] In another embodiment, general facial redness is treated.

[00216] In another embodiment, rosacea is treated.

[00217] In one embodiment, the luminescent material comprised in said second means (B) is selected such that it emits light in a wavelength range of approx. 430 nm (emission maximum) when being excited by said at least one OLED or LED comprised in said first means (A). Such irradiation device may be suitable to be used for suppressing melatonin generation.

[00218] In one embodiment, the luminescent material comprised in said second means (B) is selected such that it emits light in a wavelength range of approx. 450 nm (emission maximum) when being excited by said at least one OLED or LED comprised in said first means (A). Such irradiation device may be suitable to be used for treating neonatal jaundice.

[00219] In one embodiment, the luminescent material comprised in said second means (B) is selected such that it emits light in a wavelength range of approx. 453 nm (emission maximum) when being excited by said at least one OLED or LED comprised in said first means (A). Such irradiation device may be suitable to be used for relieving pains. It is believed that by means of such radiation the generation of NO is improved which in turn is responsible for relieving pains.

[00220] In one embodiment, the luminescent material comprised in said second means (B) is selected such that it emits light in a wavelength range of from 580-630 nm when being excited by said at least one OLED or LED comprised in said first means (A). Such irradiation device may be suitable to be used in the light orange ultraviolet therapy. Such therapy may improve the perfusion of heart and circulation, the secretion of kidneys, bowels and the skin, and/or the regulation of the nervous system and glands.

[00221] In one embodiment, the luminescent material comprised in said second means (B) is selected such that it emits light in a wavelength range of approx. 800 - 1,400 nm when being excited by said at least one OLED or LED comprised in said first means (A). Such irradiation device may be suitable to be used for treating hypertension.

[00222] In one embodiment, the luminescent material comprised in said second means (B) is selected such that it emits light in a wavelength range of approx. 1,400 - 2,000 nm when being excited by said at least one OLED or LED comprised in said

first means (A). Such irradiation device may be suitable to be used for wound healing.

[00223] In one embodiment, the treatment comprises post-laser resurfacing or post-aesthetic treatment, e.g. after filler treatment to enhance wound healing.

[00224] In one embodiment, the luminescent material comprised in said second means (B) is selected such that it emits light in the wavelength range of red light or NIR when being excited by said at least one OLED or LED comprised in said first means (A). Such irradiation device may be suitable to be used for treating acne.

[00225] In one embodiment, the luminescent material comprised in said second means (B) is selected such that it emits light in the wavelength range of from 650 nm to 1,300 nm when being excited by said at least one OLED or LED comprised in said first means (A). Radiation or light of this wavelength range is capable of penetration up to a depth of 5 mm into irradiated portions of the body of a human or an animal. Accordingly, said irradiation device may be suitable to be used in the therapy of stressed muscles, for muscle relaxation, improvement of perfusion, reduction of viscosity of synovial fluid, and/or the improvement of collagen formation.

[00226] In one embodiment, the luminescent material comprised in said second means (B) is selected such that it emits light in the wavelength range of NIR when being excited by said at least one OLED or LED comprised in said first means (A), wherein the irradiation device further comprises a light source that may emit blue or violet light. Such irradiation device may be suitable to be used for repairing DNA damages or is suitable for use in the treatment of DNA damages. It is believed that by means of such irradiation device the activity of enzymes such as photolyases may be increased which in turn may be responsible for the repair of light-induced DNA damages. LEDs based on (Al,Ga,In)N or (Ga,In)N may be used as light source for emitting said blue, violet, or near UV light (370 - 480 nm).

[00227] In an exemplary embodiment, the luminescent material is selected from the luminescent material comprised in said second means (B) such that said luminescent material emits light in the wavelength range of from 650 to 1,300 nm. Radiation or light of this wavelength range is capable of penetration up to a depth of 5 mm into irradiated portions of the body of a subject, i.e. a human or an animal.

[00228] Thus, in one embodiment, the irradiation device according to the invention is particularly effective in the therapy of stressed muscles, for muscle relaxation, improvement of perfusion, reduction of viscosity of synovial fluid, and/or the improvement of collagen formation.

[00229] Thus, said irradiation device may be suitable to be used for increasing blood flow (perfusion) of the skin and sub-cutaneous tissue, for supporting the formation of collagen tissue, and for increasing the extensibility of collagen tissue.

[00230] Cosmetic applications

[00231] In one embodiment, said therapeutic application comprises a cosmetic and / or aesthetic application or results in an aesthetic improvement of the skin.

[00232] In one embodiment, the term "*cosmetic*" encompasses the term "*aesthetic*".

[00233] In one embodiment, the aesthetic improvement concerns skin problems arising from hyperpigmentation, e.g. melasma, age spots, freckles, darker skin types, and / or general pigmentation problems.

[00234] In another embodiment, the aesthetic improvement concerns the amelioration of general facial redness.

[00235] In another embodiment, the aesthetic improvement concerns the amelioration of rosacea.

[00236] In another embodiment, the aesthetic improvement concerns post-laser resurfacing or post-aesthetic treatment, e.g. after filler treatment to enhance wound healing.

[00237] In one embodiment, the cosmetic and/or aesthetic application is selected from the group consisting of: removal of macula, removal of tattoos, removal of hairs (epilation), reduction of wrinkles, or reduction of scar tissue, treatment of hair loss, treatment or amelioration of cellulite, non-invasive treatment to improve aesthetic impression of under-chin, neck and décolletage.

[00238] The term “cellulite” (also known as *orange peel syndrome*) is a non-inflammatory variation of subcutaneous fat within fibrous connective tissue that manifests topographically as skin dimpling, often on the pelvic region (specifically the buttocks), lower limbs, and abdomen.

[00239] In one embodiment, the luminescent material of the medical patch or irradiation device is selected such that it emits light in the wavelength range of from 680 nm to 1,100 nm such as 680 nm to 700 nm (emission maxima) when used for removing macula or tattoos.

[00240] In one embodiment, the luminescent material of the medical patch or irradiation device is selected such that it emits light in the wavelength range of about 800 nm such as 810 nm (emission maximum) when used for removing hairs.

[00241] In one embodiment, the luminescent material of the medical patch or irradiation device is selected such that it emits light in the wavelength range of near infrared radiation (NIR) when used for reducing wrinkles or scar tissue or the treatment of hair loss.

[00242] ***Fourth aspect: Method of irradiating a skin, a tissue or a muscle, or a combination of two or three thereof***

[00243] According to a **fourth aspect**, the invention relates to a method of irradiating a skin, a tissue or a muscle, or a combination of two or three thereof, of a subject, the method at least comprising:

irradiating said skin, tissue or muscle, or a combination of two or three thereof, of said subject, by means of a medical patch or a medical irradiation device as defined in the **first aspect** and the **second aspect** or any embodiment defined therein.

[00244] In one embodiment, said irradiation is a light therapy, photodynamic therapy, or heat therapy, or a combination of two or three thereof.

[00245] In one embodiment, said irradiation is a therapy of stressed muscles, relaxation of muscles, improvement of perfusion, reduction of viscosity of synovial fluid, improvement of collagen formation, treatment of DNA damages, reduction of inflammatory skin reactions, treatment of atopic dermatitis, and/or treatment of pruritus.

[00246] In one embodiment, said method comprises a cosmetic and / or aesthetic application.

[00247] In one embodiment, said cosmetic and / or aesthetic application is selected from the group consisting of: removal of macula, removal of tattoos, removal of hairs (epilation), reduction of wrinkles, or reduction of scar tissue, treatment of hair loss, treatment or amelioration of cellulite, non-invasive treatment to improve aesthetic impression of under-chin, neck and décolletage.

[00248] In one embodiment, said method is a cosmetic and / or aesthetic application.

[00249] In one embodiment of said cosmetic and / or aesthetic application, said cosmetic and / or aesthetic application is selected from the group consisting of: removal of macula, removal of tattoos, removal of hairs (epilation), reduction of wrinkles, or reduction of scar tissue, treatment of hair loss, treatment or amelioration

of cellulite, non-invasive treatment to improve aesthetic impression of under-chin, neck and décolletage.

[00250] In another aspect, the light emitted by said second means (B) either of the medical patch according to the invention or the medical device according to the invention may be used for performing a therapeutic treatment or a cosmetic treatment or an aesthetic treatment or two or more thereof of a subject.

[00251] In one embodiment, if a medical patch is used for the treatment, the medical patch is brought into contact with the subject, i.e. into physical contact, preferably with a portion of the skin of the subject.

[00252] In one embodiment, if the medical device is used for the treatment, there is no need of a physical contact between device and subject.

[00253] In one embodiment, the treatment is therapeutic and cosmetic or therapeutic and aesthetic or therapeutic and cosmetic and aesthetic. In another embodiment, treatment is cosmetic and aesthetic.

[00254] The subject may be a human or an animal.

[00255] Accordingly, in one embodiment, the invention relates to a method of performing a therapeutic treatment or a cosmetic treatment or an aesthetic treatment or a combination of two or more thereof of a subject, the method comprising: directing light emitted from said second means (B) of the medical patch according to the invention, onto the subject, wherein said medical patch contacts said subject.

[00256] In another aspect, the invention relates to a method of performing a therapeutic treatment or a cosmetic treatment or an aesthetic treatment or a combination of two or more thereof of a subject, the method comprising: directing

light emitted from said second means (B) of the medical device according to the invention onto the subject.

[00257] In one embodiment, said therapeutic application is selected from the group consisting of: light therapy, photodynamic therapy, or heat therapy, or a combination of two or three thereof.

[00258] In another embodiment, said light emitted from the second means (B) is used in a light therapy, a photodynamic therapy, or a heat therapy, or a combination of two or three thereof.

[00259] **Fig. 1** exemplarily shows one embodiment of an irradiation device suitable for use according to the invention.

[00260] Medical irradiation device 10 comprises first means 1, second means 2, and third means 3. First means 1 comprises a blue LED which is accommodated in a housing comprising an electric circuit for switching said LED on and off as indicated in said figure. Means 1 is connected to means 3 which is an optical waveguide. Waveguide 3 may be flexible. Said means 2 is construed in the form of a plate-like arrangement. Waveguide 3 is connected to means 2 at an edge thereof. Means 2 includes a luminescent material 2a, which is incorporated in a gel-like polymeric material 2b. The concentration of luminescent material is lower at the place where waveguide 3 is connected to second means 2 compared to the concentration at the other end of second means 2 (indicated by the darker shade at said other end of second means 2). Second means 2 is covered by cover means 2c, e.g. in the form of a textile tissue, wherein said second means (B) has a light emitting surface where emitted light leaves said surface (symbolized by arrows), and the cover means (G) prevents light being emitted from other surfaces of the second means (B) than said light emitting surface.

[00261] **Fig. 2** exemplarily shows another embodiment of a medical irradiation device according to the invention.

[00262] Medical irradiation device 100 comprises first means 1, second means 2, and third means 3. First means 1 comprises a blue LED which is accommodated in a housing comprising an electric circuit for switching said LED on and off as indicated in said figure. Means 1 is connected to means 3 which is a waveguide. Waveguide 3 may be flexible. Means 2 is construed in the form of a plate-like arrangement. Waveguide 3 is connected to means 2 at the centre thereof. Further, waveguide 3 includes a lens 3a for effectively guiding light to second means 2. Second means 2 includes a luminescent material 2a, which is incorporated in a gel-like polymeric material 2b. The concentration of luminescent material is lower at the centre where waveguide 3 enters means 2 compared to the concentration at places adjacent thereof (indicated by the darker shades towards the ends of second means 2). Second means 2 is covered by cover means 2c, e.g. in the form of a textile tissue, wherein said second means (B) has a light emitting surface where emitted light leaves said surface (symbolized by arrows), and the cover means (G) prevents light being emitted from other surfaces of the second means (B) than said light emitting surface.

[00263] In another aspect, the invention relates to the following items 1 to 15:

1. Medical patch, comprising:

- a light entry portion (X);
- a light converting portion (Y); and
- a light emitting portion (Z);

and further comprising first means (A), second means (B) and third means (C);

- (X) being configured to receive light from said third means (C) comprising an optical waveguide;
 - (Y) comprising said second means (B) comprising at least one luminescent material configured to emit light by converting light emitted from at least one OLED or LED (A); in one embodiment, said luminescent material is a luminescent organic compound or a quantum dot-comprising material;
 - (Z) being configured to contact and irradiate a skin, a tissue or a muscle, or a combination of two or three thereof.
2. Medical patch according to item 1, wherein said third means(C) comprising said optical waveguide receives light from said
- (A) first means comprising at least one OLED or LED configured to emit said light.
3. Medical patch according to item 1 or 2, wherein the light converting portion (Y) comprises
- (B) second means comprising at least one luminescent material configured to emit light by converting said light emitted from said at least one OLED or LED (A).
4. Medical patch according to any one of items 1 to 3, wherein said
- (C) third means comprising said optical waveguide is configured to guide said light emitted by said at least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B).
5. Medical patch according to any one of the preceding claims, wherein said third means (C) connects the first means (A) to the second means (B).

6. Medical patch according to any one of the preceding items, wherein said first means (A) and said second means (B) are not in physical contact with one another.
7. Medical patch according to any one of the preceding items, wherein said third means (C) receives the light from said first means (A) and emits the light in a first light direction, wherein the second means (B) is configured to emit light in a second light direction, which differs from the first light direction by an angle α , preferably by $0^\circ < \alpha \leq 90^\circ$.
8. Medical patch according to any one of the preceding items, wherein
 - (A) said at least one LED comprised in the first means (A) comprises (In,Ga)N or (Al,In,Ga)N and is configured to emit light in the wavelength range of from 370 to 480 nm;

wherein said at least one luminescent material comprised in the second means (B) comprises a luminescent organic compound or a quantum dot comprising material, preferably selected from the group comprising or consisting of:

a perylene dye, a triphenylene dye, a naphthalimide dye, a xanthene dye, a phenoxazine dye, an acridine dye, an anthracene dye, a phenazine dye, or a coumarin dye, or two or more thereof;

or

wherein said at least one luminescent material comprised in the second means (B) comprises a compound selected from the group comprising or consisting of:

$\text{Sr}_4\text{Al}_{14}\text{O}_{25}:\text{Eu}^{2+}$, $\text{BaSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $(\text{Ba},\text{Sr})_2\text{SiO}_4:\text{Eu}^{2+}$, $\text{Lu}_3(\text{Al},\text{Ga},\text{Sc})_5\text{O}_{12}:\text{Ce}^{3+}$,
 $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Gd}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{SrSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $\text{SrGa}_2\text{S}_4:\text{Eu}^{2+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$,
 $\text{Tb}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{CaSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $\text{La}_3\text{Si}_6\text{N}_{11}:\text{Ce}^{3+}$, $(\text{Y},\text{Gd})_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$,

$\text{SrLi}_2\text{SiO}_4:\text{Eu}^{2+}$, $\text{Ba}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{Ca}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{Sr}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{LiSrAl}_3\text{N}_4:\text{Eu}^{2+}$,
 $(\text{Ca},\text{Sr})\text{AlSiN}_3:\text{Eu}^{2+}$, $\text{CaS}:\text{Eu}^{2+}$, $\text{Mg}_4\text{GeFO}_{5.5}:\text{Mn}^{4+}$, $\text{MgAl}_2\text{O}_4:\text{Cr}^{3+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Cr}^{3+}$,
 $\text{GdMgAl}_{11}\text{O}_{19}:\text{Cr}^{3+}$, $\text{Al}_2\text{O}_3:\text{Cr}^{3+}$, $\text{BaMgAl}_{10}\text{O}_{17}:\text{Cr}^{3+}$, $\text{SrB}_4\text{O}_7:\text{Sm}^{2+}$, $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Cr}^{3+}$,
 $\text{LiAl}_5\text{O}_8:\text{Cr}^{3+}$, $\text{GdAlO}_3:\text{Cr}^{3+}$, $\text{Y}_3\text{Ga}_5\text{O}_{12}:\text{Cr}^{3+}$, $\text{LaAlO}_3:\text{Cr}^{3+}$, $\text{Gd}_3\text{Ga}_5\text{O}_{12}:\text{Cr}^{3+}$,
 $\text{Mg}_2\text{SiO}_4:\text{Cr}^{3+}\text{Li}^+$, $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Gd}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$,
 $\text{Tb}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Ca}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Sr}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$, $\text{Ba}_2\text{Si}_5\text{N}_8:\text{Ce}^{3+}\text{Nd}^{3+}$,
 $\text{Ca}_2\text{Al}_2\text{SiO}_7:\text{Ce}^{3+}$, $\text{YBO}_3:\text{Ce}^{3+}$, $\text{CaY}_2\text{Al}_2\text{O}_7:\text{Ce}^{3+}$, $\text{CaAl}_2\text{Si}_2\text{O}_8:\text{Eu}^{2+}$, $\text{CaAl}_2\text{O}_4:\text{Eu}^{2+}$,
 $\text{CaMgSi}_2\text{O}_6:\text{Eu}^{2+}$, $\text{Y}_2\text{SiO}_5:\text{Ce}^{3+}$, $\text{Sr}_2\text{ZnSi}_2\text{O}_7:\text{Eu}^{2+}$, $\text{Sr}_3\text{Al}_{10}\text{SiO}_{20}:\text{Eu}^{2+}$,
 $\text{Sr}_2\text{MgSi}_2\text{O}_7:\text{Eu}^{2+}$, $\text{SrAl}_4\text{O}_7:\text{Eu}^{2+}$, $\text{Sr}_3\text{MgSi}_2\text{O}_8:\text{Eu}^{2+}$, $\text{ZnO}:\text{Zn}$, $\text{Ba}(\text{Zr},\text{Hf})\text{Si}_3\text{O}_9:\text{Eu}^{2+}$,
 $\text{SrSiAl}_2\text{O}_3\text{N}:\text{Eu}^{2+}$, Mg_2SnO_4 , $\text{Ca}_9\text{Y}(\text{PO}_4)_7$, $\text{Y}_3\text{AlGa}_4\text{O}_{12}:\text{Ce}^{3+}$, ZnGa_2O_4 ,
 $\text{Ba}_2\text{MgSi}_2\text{O}_7:\text{Eu}^{2+}$, $\text{Lu}_3\text{Al}_2\text{Ga}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{CaY}_2\text{Al}_4\text{GeO}_{12}:\text{Ce}^{3+}$, $\text{CaY}_2\text{Al}_4\text{GeO}_{12}:\text{Ce}^{3+}$,
 ZnAl_2O_4 , $\text{Y}_3\text{Al}_2\text{Ga}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{Lu}_3\text{ScAl}_4\text{O}_{12}:\text{Ce}^{3+}$, $\text{SrSi}_2\text{AlN}_3\text{O}_2:\text{Eu}^{3+}$,
 $\text{CaSc}_2\text{O}_4:\text{Ce}^{3+}$, $\text{Y}_3\text{Al}_3\text{Ga}_2\text{O}_{12}:\text{Ce}^{3+}$, $\text{Zn}_2\text{SiO}_4:\text{Mn}^{2+}$, $(\text{Sr}_{0.5}\text{Ba}_{0.5})_2\text{SiO}_4:\text{Eu}^{2+}$,
 $\text{Y}_3\text{Al}_4\text{GaO}_{12}:\text{Ce}^{3+}$, $\text{Zn}_2\text{GeO}_4:\text{Mn}^{2+}$, $\text{CaLu}_2\text{Al}_4\text{SiO}_{12}:\text{Ce}^{3+}$, $\text{Y}_2\text{GdAl}_5\text{O}_{12}:\text{Ce}^{3+}$,
 $\text{CaY}_2\text{Al}_4\text{SiO}_{12}:\text{Ce}^{3+}$, $\text{Mg}_3\text{Y}_2\text{Ge}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{YGd}_2\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Mg}_3\text{YGdGe}_3\text{O}_{12}:\text{Ce}^{3+}$,
 $\text{Mg}_3\text{Y}_{0.25}\text{Gd}_{0.75}\text{Ge}_3\text{O}_{12}:\text{Ce}^{3+}$, $\text{Ba}_2\text{Mg}(\text{BO}_3)_2:\text{Yb}^{2+}$, $\text{Mg}_3\text{Gd}_2\text{Ge}_3\text{O}_{12}:\text{Ce}^{3+}$,
 $\text{Mg}_3\text{Gd}_2\text{Ge}_2\text{SiO}_{12}:\text{Ce}^{3+}$, $\text{LiEu}(\text{Mo},\text{W})_2\text{O}_8:\text{Eu}^{3+}$, $\text{Sr}[\text{Mg}_3\text{SiN}_4]:\text{Eu}^{2+}$, $\text{SrSi}_2\text{N}_2\text{O}_2:\text{Yb}^{2+}$,
 $\text{Sr}[\text{LiAl}_3\text{N}_4]:\text{Eu}^{2+}$, $\text{Mg}_{14}\text{Ge}_5\text{O}_{24}:\text{Mn}^{4+}$, $\text{K}_2\text{Ge}_4\text{O}_9:\text{Mn}^{4+}$, $\text{Li}_2\text{Ge}_4\text{O}_9:\text{Mn}^{4+}$,
 $\text{Na}_2\text{CaGe}_5\text{SiO}_{14}:\text{Mn}^{4+}$, $\text{Ca}_2\text{GdNbO}_6:\text{Mn}^{4+}$, $\text{Ca}_2\text{YNbO}_6:\text{Mn}^{4+}$, $\text{Ca}_2\text{LuNbO}_6:\text{Mn}^{4+}$,
 $\text{Sr}_3\text{Al}_2\text{Ge}_4\text{O}_{14}:\text{Mn}^{4+}$, $\text{Ca}_2\text{ScNbO}_6:\text{Mn}^{4+}$, $\text{Ca}_2\text{LaNbO}_6:\text{Mn}^{4+}$, $\text{Y}_2\text{MgTiO}_6:\text{Mn}^{4+}$,
 $\text{LaScO}_3:\text{Mn}^{4+}$, $\text{La}_3\text{Mg}_2\text{TaO}_9:\text{Mn}^{4+}$, $\text{LaMgTiO}_6:\text{Mn}^{4+}$, $\text{MgLa}_2\text{GeO}_6:\text{Mn}^{4+}$,
 $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Tb}^{3+}\text{Yb}^{3+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Tb}^{3+}\text{Yb}^{3+}$, $\text{LaMgAl}_{11}\text{O}_{19}:\text{Mn}^{4+}$, or a mixture of two or
more thereof.

9. Medical patch according to any one of the preceding items, wherein said luminescent material comprised in the second means (B) is distributed such in said second means (B) to form one or more concentration gradients.

10. Medical patch according to any one of the preceding items, said second means (B) comprises cover means (G), wherein the second means (B) has a light emitting surface, and the cover means (G) prevents light being emitted from other surfaces of the second means (B) than said light emitting surface.
11. Medical patch according to any one of the preceding items, wherein said optical waveguide comprised in the third means (C) is in the form of a fiber.
12. Medical patch according to any one of the preceding items, wherein at least a part of said optical waveguide comprised in the third means (C) forms at least a part of the second means (B).
13. Medical patch according to any one of the preceding items, wherein said optical waveguide comprised in said third means (C) is configured to be detachable from the first means (A) or from the second means (B) or from the first means (A) and the second means (B).
14. Medical irradiation device comprising:
 - (A) first means comprising at least one OLED or LED configured to emit light;
 - (B) second means comprising at least one luminescent material configured to emit light by converting said light emitted from said at least one first means (A) comprising at least one OLED or LED; wherein said luminescent material is a luminescent organic compound or a quantum dot-comprising material;
 - (C) third means comprising an optical waveguide configured to guide said light emitted by said at least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B);

wherein said third means (C) connects the first means (A) to the second means (B).

15. Luminescent material for use in the irradiation of a skin, a tissue or a muscle, or a combination of two or three thereof, of a subject, the luminescent material being comprised in an irradiation device, the irradiation device comprising:

- (A) first means comprising at least one OLED or LED configured to emit light;
- (B) second means comprising at least one luminescent material configured to emit light by converting said light emitted from said at least one OLED or LED (A); wherein said luminescent material is a luminescent organic compound or a quantum dot-comprising material;
- (C) third means comprising an optical waveguide configured to guide said light emitted by said at least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B);

wherein said third means (C) connects the first means (A) to the second means (B); and

wherein said light emitted by said at least one luminescent material comprised in said second means (B) is used for said irradiation of a skin, a tissue or a muscle, or a combination of two or three thereof, of said subject.

[00264] Reference signs

10, 100	medical irradiation device
1	first means including a blue LED
2	second means
2a	luminescent material
2b	gel-like polymeric material
2c	cover means
3	third means (waveguide)
3a	lens
X	light entry portion
Y	light converting portion
Z	light emitting portion

EXAMPLES

Example 1

[00265] CaS:Eu^{2+} [luminescent material comprised in the first means (B)] coated with SiO_2 [coating material (E)] is suspended in a commercial liquid silicone resin precursor. Subsequently, a polymerization catalyst is added to said suspension. Immediately after the addition of the catalyst, a defined portion of the resulting mixture is applied onto a waveguide [waveguide comprised in third means (C)] based on poly(methylmethacrylate). The resulting structure may be defined as a screen containing said luminescent material comprised in the second means (B), wherein said screen is provided on a waveguide comprised in said third means (C). This structure is attached to an LED array based on $(\text{In,Ga})\text{N}$ [LED (A)]. The spectrum of said irradiation device shows an emission maximum at 455 nm stemming from said LED comprised in first means (A) and a further emission maximum at 650 nm stemming from said luminescent material comprised in second means (B). The intensity of light emitted by the luminescent material varies in dependence of the thickness of the polymer layer applied to said waveguide.

Example 2

[00266] $\text{SrGa}_2\text{S}_4:\text{Eu}^{2+}$ [luminescent material comprised in second means (B)] coated with SiO_2 [coating material (E)] is suspended in a commercial liquid silicone resin precursor. Subsequently, a polymerization catalyst is added to said suspension. Immediately after the addition of the catalyst, a defined portion of the resulting mixture is applied onto a waveguide [waveguide comprised in third means (C)] based on poly(methylmethacrylate). The resulting structure may be defined as a screen

containing said luminescent material, wherein said screen is provided on a waveguide comprised in third means (C). The resulting structure is attached to an LED array based on (In,Ga)N [LED comprised in first means (A)]. The spectrum of said irradiation device shows an emission maximum at 455 nm stemming from said LED and a further emission maximum at approx., 535 nm stemming from said luminescent material. The intensity of light emitted by the luminescent material varies in dependence of the thickness of the polymer layer applied to the waveguide.

Example 3

[00267] $\text{SrLi}_2\text{SiO}_4:\text{Eu}^{2+}$ [luminescent material comprised in second means (B)] coated with SiO_2 [coating material (E)] is suspended in a commercial liquid silicone resin precursor. Subsequently, a polymerization catalyst is added to said suspension. Immediately after the addition of the catalyst, a defined portion of the resulting mixture is applied onto a waveguide [waveguide comprised in third means (C)] based on poly(methylmethacrylate). The resulting structure may be defined as a screen containing said luminescent material comprised in the second means (B), wherein said screen is provided on a waveguide comprised in third means (C). The resulting structure is attached to an LED array based on (In,Ga)N [LED (A)]. The spectrum of said irradiation device shows an emission maximum at 455 nm stemming from said LED comprised in first means (A) and a further emission maximum at 580 nm stemming from said luminescent material comprised in second means (B). The intensity of light emitted by the luminescent material varies in dependence of the thickness of the polymer layer applied to said waveguide.

Example 4

[00268] $\text{CaAlSiN}_3:\text{Eu}^{2+}$ [luminescent material B] coated with SiO_2 [coating material (E)] is suspended in a commercial liquid silicone resin precursor. Subsequently, a

polymerization catalyst is added to said suspension. Immediately after the addition of the catalyst, a defined portion of the resulting mixture is applied onto a waveguide [waveguide (C)] based on poly (methylmethacrylate). The resulting structure may be defined as a screen containing said luminescent material (B), wherein said screen is provided on a waveguide (C). The resulting structure is attached to an LED array based on (In,Ga)N [LED (A)]. The spectrum of said irradiation device shows an emission maximum at 455 nm stemming from said LED (A) and a further emission maximum at 650 nm stemming from said luminescent material (B). The intensity of light emitted by the luminescent material (B) varies in dependence of the thickness of the polymer layer applied to waveguide (C).

Example 5

[00269] Lumogen® F Red 305 [luminescent material comprised in the second means (B)] is suspended in a commercial liquid silicone resin precursor. Subsequently, a polymerization catalyst is added to said suspension. Immediately after the addition of the catalyst, a defined portion of the resulting mixture is applied onto a waveguide [waveguide comprised in third means (C)] based on poly(methylmethacrylate). The resulting structure may be defined as a screen containing said luminescent material comprised in the second means (B), wherein said screen is provided on a waveguide comprised in said third means (C). This structure is attached to an LED array based on (In,Ga)N [LED (A)]. The spectrum of said irradiation device shows an emission maximum at 470 nm stemming from said LED comprised in first means (A) and a further emission maximum at 670 nm stemming from said luminescent material comprised in second means (B). The intensity of light emitted by the luminescent material varies in dependence of the thickness of the polymer layer applied to said waveguide.

Example 6

[00270] Lumogen® F Orange 240 [luminescent material comprised in second means (B)] is suspended in a commercial liquid silicone precursor. Subsequently, a polymerization catalyst is added to said suspension. Immediately after the addition of the catalyst, a defined portion of the resulting mixture is applied onto a waveguide [waveguide comprised in third means (C)] based on poly(methylmethacrylate). The resulting structure may be defined as a screen containing said luminescent material, wherein said screen is provided on a waveguide comprised in third means (C). The resulting structure is attached to an LED array based on (In,Ga)N [LED comprised in first means (A)]. The spectrum of said irradiation device shows an emission maximum at 470 nm stemming from said LED and a further emission maximum at approx., 570 nm accompanied by two further lower emissions at approx. 540 nm and 625 nm stemming from said luminescent material. The intensity of light emitted by the luminescent material varies in dependence of the thickness of the polymer layer applied to the waveguide.

Example 7

[00271] A mixture of Lumogen® F Yellow ED 206 and Lumogen® F Red 305 [luminescent material comprised in second means (B)] is suspended in a commercial liquid silicone resin precursor. Subsequently, a polymerization catalyst is added to said suspension. Immediately after the addition of the catalyst, a defined portion of the resulting mixture is applied onto a waveguide [waveguide comprised in third means (C)] based on poly(methylmethacrylate). The resulting structure may be defined as a screen containing said luminescent material comprised in the second means (B), wherein said screen is provided on a waveguide comprised in third means (C). The resulting structure is attached to an LED array based on (In,Ga)N [LED (A)]. The spectrum of said irradiation device shows an emission maximum at 470 nm stemming from said LED comprised in first means (A) and a further

emissions at 520 nm, 550 nm and 605 nm nm stemming from said luminescent materials comprised in second means (B). The intensity of light emitted by the luminescent material varies in dependence of the thickness of the polymer layer applied to said waveguide.

CLAIMS

1. Medical patch, comprising:

a light entry portion (X);
a light converting portion (Y); and
a light emitting portion (Z);

and further comprising first means (A), second means (B) and third means (C);

the light entry portion (X) being configured to receive light from said third means (C) comprising an optical waveguide;

the light converting portion (Y) comprising said second means (B) comprising at least one luminescent material configured to emit light by converting light emitted from said first means (A) comprising at least one OLED or LED;

the light emitting portion (Z) being configured to contact and irradiate a skin, a tissue or a muscle, or a combination of two or three thereof;

wherein

said third means (C) comprising said optical waveguide receives light from said first means (A) comprising at least one OLED or LED configured to emit said light;

said third means (C) comprising said optical waveguide is configured to guide said light emitted by said at least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B);

wherein said third means (C) connects said first means (A) to said second means (B); and

wherein said optical waveguide comprised in said third means (C) is configured to be detachable from said first means (A) or from said second means (B) or from said first means (A) and said second means (B).

2. Medical patch according to claim 1, wherein said first means (A) and said second means (B) are not in physical contact with one another.
3. Medical patch according to any one of the preceding claims, wherein said third means (C) receives the light from said first means (A) and emits the light in a first light direction, wherein the second means (B) is configured to emit light in a second light direction, which differs from the first light direction by an angle α , preferably by $0^\circ < \alpha \leq 90^\circ$.
4. Medical patch according to any one of the preceding claims, wherein

said at least one LED comprised in the first means (A) comprises (In,Ga)N or (Al,In,Ga)N and is configured to emit light in the wavelength range of from 370 to 480 nm;

wherein said at least one luminescent material comprised in the second means (B) comprises an inorganic compound selected from the group comprising or consisting of:

$\text{Sr}_4\text{Al}_{14}\text{O}_{25}:\text{Eu}^{2+}$, $\text{BaSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $(\text{Ba},\text{Sr})_2\text{SiO}_4:\text{Eu}^{2+}$, $\text{Lu}_3(\text{Al},\text{Ga},\text{Sc})_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Lu}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Gd}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{SrSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $\text{SrGa}_2\text{S}_4:\text{Eu}^{2+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{Tb}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{CaSi}_2\text{N}_2\text{O}_2:\text{Eu}^{2+}$, $\text{La}_3\text{Si}_6\text{N}_{11}:\text{Ce}^{3+}$, $(\text{Y},\text{Gd})_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$, $\text{SrLi}_2\text{SiO}_4:\text{Eu}^{2+}$, $\text{Ba}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{Ca}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{Sr}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$, $\text{LiSrAl}_3\text{N}_4:\text{Eu}^{2+}$, $(\text{Ca},\text{Sr})\text{AlSiN}_3:\text{Eu}^{2+}$, $\text{CaS}:\text{Eu}^{2+}$, $\text{Mg}_4\text{GeFO}_{5.5}:\text{Mn}^{4+}$, $\text{MgAl}_2\text{O}_4:\text{Cr}^{3+}$, $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Cr}^{3+}$,

GdMgAl₁₁O₁₉:Cr³⁺, Al₂O₃:Cr³⁺, BaMgAl₁₀O₁₇:Cr³⁺, SrB₄O₇:Sm²⁺, Lu₃Al₅O₁₂:Cr³⁺, LiAl₅O₈:Cr³⁺, GdAlO₃:Cr³⁺, Y₃Ga₅O₁₂:Cr³⁺, LaAlO₃:Cr³⁺, Gd₃Ga₅O₁₂:Cr³⁺, Mg₂SiO₄:Cr³⁺Li⁺, Lu₃Al₅O₁₂:Ce³⁺Nd³⁺, Y₃Al₅O₁₂:Ce³⁺Nd³⁺, Gd₃Al₅O₁₂:Ce³⁺Nd³⁺, Tb₃Al₅O₁₂:Ce³⁺Nd³⁺, Ca₂Si₅N₈:Ce³⁺Nd³⁺, Sr₂Si₅N₈:Ce³⁺Nd³⁺, Ba₂Si₅N₈:Ce³⁺Nd³⁺, Ca₂Al₂SiO₇:Ce³⁺, YBO₃:Ce³⁺, CaY₂Al₂O₇:Ce³⁺, CaAl₂Si₂O₈:Eu²⁺, CaAl₂O₄:Eu²⁺, CaMgSi₂O₆:Eu²⁺, Y₂SiO₅:Ce³⁺, Sr₂ZnSi₂O₇:Eu²⁺, Sr₃Al₁₀SiO₂₀:Eu²⁺, Sr₂MgSi₂O₇:Eu²⁺, SrAl₄O₇:Eu²⁺, Sr₃MgSi₂O₈:Eu²⁺, ZnO:Zn, Ba(Zr,Hf)Si₃O₉:Eu²⁺, SrSiAl₂O₃N:Eu²⁺, Mg₂SnO₄, Ca₉Y(PO₄)₇, Y₃AlGa₄O₁₂:Ce³⁺, ZnGa₂O₄, Ba₂MgSi₂O₇:Eu²⁺, Lu₃Al₂Ga₃O₁₂:Ce³⁺, CaY₂Al₄GeO₁₂:Ce³⁺, CaY₂Al₄GeO₁₂:Ce³⁺, ZnAl₂O₄, Y₃Al₂Ga₃O₁₂:Ce³⁺, Lu₃ScAl₄O₁₂:Ce³⁺, SrSi₂AlN₃O₂:Eu³⁺, CaSc₂O₄:Ce³⁺, Y₃Al₃Ga₂O₁₂:Ce³⁺, Zn₂SiO₄:Mn²⁺, (Sr_{0.5}Ba_{0.5})₂SiO₄:Eu²⁺, Y₃Al₄GaO₁₂:Ce³⁺, Zn₂GeO₄:Mn²⁺, CaLu₂Al₄SiO₁₂:Ce³⁺, Y₂GdAl₅O₁₂:Ce³⁺, CaY₂Al₄SiO₁₂:Ce³⁺, Mg₃Y₂Ge₃O₁₂:Ce³⁺, YGd₂Al₅O₁₂:Ce³⁺, Mg₃YGdGe₃O₁₂:Ce³⁺, Mg₃Y_{0.25}Gd_{0.75}Ge₃O₁₂:Ce³⁺, Ba₂Mg(BO₃)₂:Yb²⁺, Mg₃Gd₂Ge₃O₁₂:Ce³⁺, Mg₃Gd₂Ge₂SiO₁₂:Ce³⁺, LiEu(Mo,W)₂O₈:Eu³⁺, Sr[Mg₃SiN₄]:Eu²⁺, SrSi₂N₂O₂:Yb²⁺, Sr[LiAl₃N₄]:Eu²⁺, Mg₁₄Ge₅O₂₄:Mn⁴⁺, K₂Ge₄O₉:Mn⁴⁺, Li₂Ge₄O₉:Mn⁴⁺, Na₂CaGe₅SiO₁₄:Mn⁴⁺, Ca₂GdNbO₆:Mn⁴⁺, Ca₂YNbO₆:Mn⁴⁺, Ca₂LuNbO₆:Mn⁴⁺, Sr₃Al₂Ge₄O₁₄:Mn⁴⁺, Ca₂ScNbO₆:Mn⁴⁺, Ca₂LaNbO₆:Mn⁴⁺, Y₂MgTiO₆:Mn⁴⁺, LaScO₃:Mn⁴⁺, La₃Mg₂TaO₉:Mn⁴⁺, LaMgTiO₆:Mn⁴⁺, MgLa₂GeO₆:Mn⁴⁺, Lu₃Al₅O₁₂:Tb³⁺Yb³⁺, Y₃Al₅O₁₂:Tb³⁺Yb³⁺, LaMgAl₁₁O₁₉:Mn⁴⁺, or a mixture of two or more thereof; or

wherein said at least one luminescent material comprised in the second means (B) comprises a luminescent organic compound or a quantum dot-comprising material; preferably selected from the group comprising or consisting of:

a perylene dye, a triphenylene dye, a naphthalimide dye, a xanthene dye, a phenoxazine dye, an acridine dye, an anthracene dye, a phenazine dye, or a coumarin dye, or two or more thereof;

or wherein said at least one luminescent material comprised in the second means (B) comprises one or more of said inorganic compounds and one or more of said organic compounds or quantum dot-comprising materials.

5. Medical patch according to any one of the preceding claims, wherein said luminescent material comprised in the second means (B) is distributed such in said second means (B) to form one or more concentration gradients.
6. Medical patch according to any one of the preceding claims, said second means (B) comprises cover means (G), wherein the second means (B) has a light emitting surface, and the cover means (G) prevents light being emitted from other surfaces of the second means (B) than said light emitting surface.
7. Medical patch according to any one of the preceding claims, wherein said optical waveguide comprised in the third means (C) is in the form of a fiber.
8. Medical patch according to claim 7, wherein said fiber comprises or consists of a fiber selected from the group consisting of: hollow optical fiber, photonic-crystal fiber or hollow photonic-crystal fiber, or two or more thereof.
9. Medical patch according to any one of the preceding claims, wherein at least a part of said optical waveguide comprised in the third means (C) forms at least a part of the second means (B).
10. Medical patch according to any one of the preceding claims, wherein said second means (B) comprises at least one optical element (F) which is configured to increase the efficiency of the light output of said at least one luminescent material comprised in the second means (B).

11. Medical patch according to claim 10, wherein said at least one optical element (F) comprises or consists of a light distributing structure that distributes the light emitted from said at least one first means (A).
12. Medical patch according to claim 10 or 11, wherein said at least one optical element (F) comprises or consists of a reflector device, wherein said reflector device is arranged such to at least partially enclose an area of said second means (B) comprising said at least one luminescent material.
13. Medical patch according to any one of the preceding claims, comprising at least one of the following for detachably connecting said waveguide comprised in the third means (C) to said first means (A) or to said a second means (B) or to the first means (A) and the second means (B):
 - a connector system comprising a plug and a socket;
 - a receiving portion for receiving an end portion of said waveguide, wherein said receiving portion comprises a cavity configured to contain an optical gel, and preferably containing said optical gel; and/or
 - a cleavable fusion splice.
14. Medical irradiation device comprising:
 - first means (A) comprising at least one OLED or LED configured to emit light;
 - second means (B) comprising at least one luminescent material configured to emit light by converting said light emitted from said at least one OLED or LED (A);
 - third means (C) comprising an optical waveguide configured to guide said light emitted by said at least one OLED or LED comprised in said first means (A) to said at least one luminescent material comprised in said second means (B);

wherein said third means (C) connects the first means (A) to the second means (B);

wherein said third means (C) connects the first means (A) to the second means (B); and wherein said optical waveguide comprised in said third means (C) is configured to be detachable from the first means (A) or from the second means (B) or from the first means (A) and the second means (B).

15. Luminescent material for use in a therapeutic application, wherein the therapeutic application comprises or consists of the irradiation of a skin, a tissue or a muscle, or a combination of two or three thereof, of a subject, the luminescent material being comprised in a medical patch as defined in any one of claims 1 to 13, or in a medical device as defined in claim 14,

wherein said light emitted by said at least one luminescent material comprised in said second means (B) is used for said irradiation of a skin, a tissue or a muscle, or a combination of two or three thereof, of said subject.

16. Luminescent material for use according to claim 15, wherein said irradiation is a light therapy, photodynamic therapy, or heat therapy, or a combination of two or more thereof.

17. Luminescent material for use according to any one of claims 15 to 16, wherein said therapeutic application comprises a cosmetic application or aesthetic application or a cosmetic and an aesthetic application.

18. Method of performing a therapeutic treatment or a cosmetic treatment or an aesthetic treatment or a combination of two or more thereof of a subject, the method comprising: directing light emitted from said second means (B) of the medical patch as defined in any one of claims 1 to 13 onto the subject, wherein said medical patch contacts said subject.

19. Method of performing a therapeutic treatment or a cosmetic treatment or an aesthetic treatment or a combination of two or more thereof of a subject, the method comprising: directing light emitted from said second means (B) of the medical irradiation device as defined in claim 14 onto the subject.

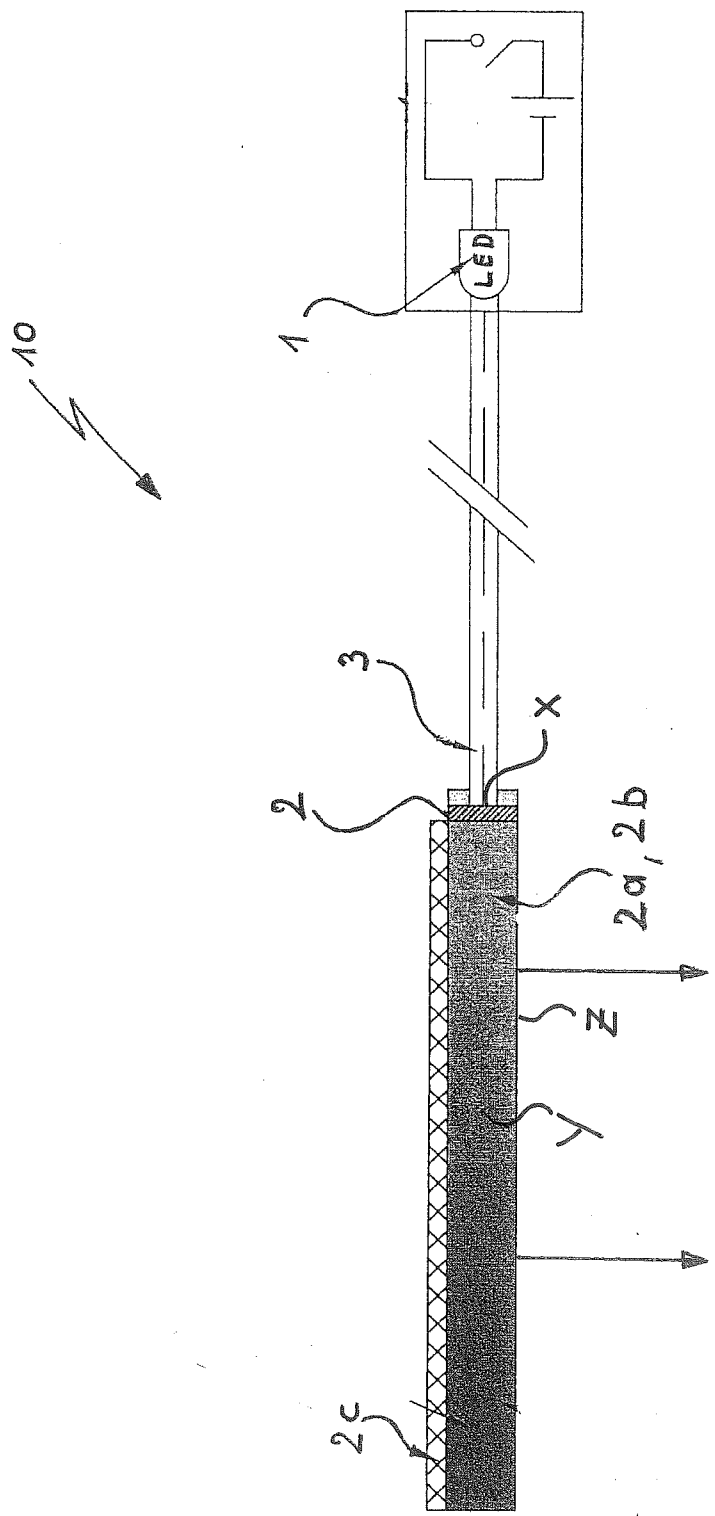


Fig. 1

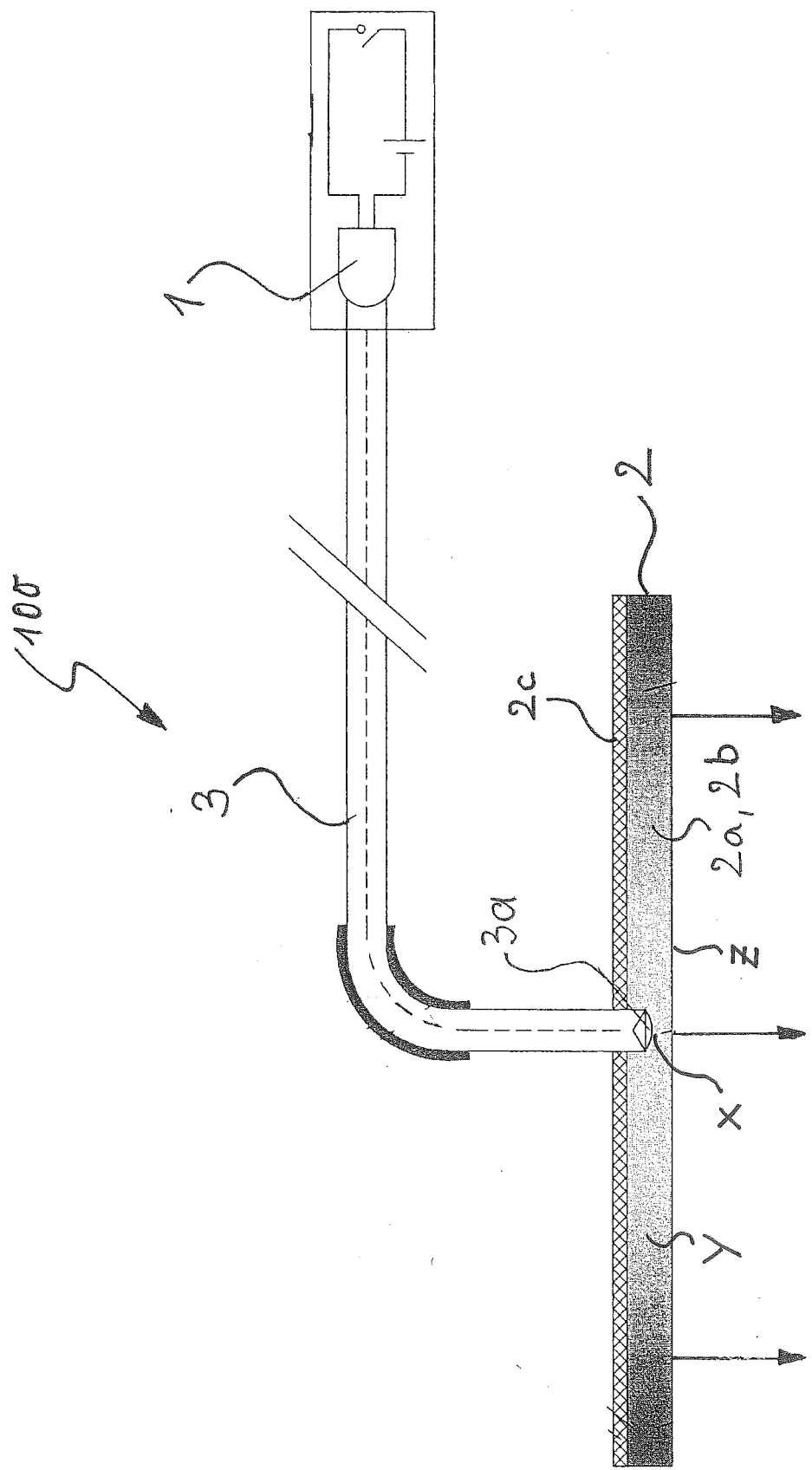


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/058960

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61N5/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/289885 A1 (COTTRELL WILLIAM JUDE [US] ET AL) 15 November 2012 (2012-11-15) paragraphs [0003], [0058], [0060] - [0062], [0076], [0085], [0087]; claims 24,31; figures 5,6a,7a,14a, 15a,16a	1-7,9-19
A	-----	8
X	US 2012/182758 A1 (NATH GUENTHER [DE]) 19 July 2012 (2012-07-19) paragraphs [0045] - [0047], [0056], [0060], [0065] - [0069], [0071], [0075]; claims 15,17; figures 2, 4	14-17,19



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

6 June 2017

Date of mailing of the international search report

19/06/2017

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/058960

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012289885 A1	15-11-2012	AU 2012256023 A1	09-01-2014
		CA 2836124 A1	22-11-2012
		GB 2505796 A	12-03-2014
		US 2012289885 A1	15-11-2012
		WO 2012158570 A1	22-11-2012

US 2012182758 A1	19-07-2012	DE 102012100375 A1	19-07-2012
		US 2012182758 A1	19-07-2012
