photons, have an endogenous bacteria killing effect although the depth to which the photons penetrate into the tissue is smaller than for the low energy photos.

Thus, the same target area can be activated through photon up-conversion reactions where two or more photons are simultaneously absorbed and cause the target molecule(s) to excite to a higher energy state.

In one aspect, the present disclosure provides the use of a sensitizer in the manufacture of a medicament for the topical treatment of an infection on a mammal, wherein said sensitizer is to be applied to a part of skin or mucous membrane and said part is to be subsequently or simultaneously subjected to first photons with a majority energy between 2.95 eV and 3.17 eV; and second photons with a majority energy between 1.4 eV and 1.6 eV, wherein said sensitizer comprises at least one photosensitizer selected from the group of natural compounds comprising hypericin, curcumin, Cercosporin, psoralen, xanthotoxin, Angelicin, alpha-Terthienyl, Phenylthepatriyne, THC, Cannabidiol (CBD) and combinations thereof, and the group of synthetic photosensitizers comprising RB (Rose Bengal), Methylene Blue, Indocyanine Green, Erythosine, resveratrol, berry 10 extracts, such as lingonberry and blueberry including polyphenolic compounds and/or anthocyanine compounds and combinations thereof, or the photosensitizer being the combination of at least one photosensitizer is selected from the group of natural compounds listed above and at least one photosensitizer is selected from the group of synthetic compounds listed above.

In one example, a method is provided wherein the target area is contacted with a photosensitizer and then the target area thus treated will be subjected to the combination of first photons having a majority energy between 1.24 eV and 1.65 eV and second photons having a majority energy between 2.8 eV and 3.5 eV, said first and said second photons making up a majority, preferably more than 90 %, of all photons directed towards the target area.

A further example provides a photosensitizer for use in the topical treatment of an infection on a mammal, wherein said sensitizer is applied to a part of skin or mucous membrane and that part is subsequently or simultaneously subjected to first photons with a majority energy between 2.8 eV and 3.5 eV; and second photons with a majority energy between 1.24 eV and 1.65 eV.

In one example, a photosensitizer is provide for use in topical treatment of an infection on a mammal, wherein said sensitizer is first applied to a part of the skin or mucous membrane and that part is subsequently or simultaneously subjected to photons with a majority energy between 3.17 eV and 2.95 eV and 1.56 eV and 1.45 eV, respectively. Such energy levels correspond to wave lengths of about 390 to 420 nm and 795 to 855 nm, respectively.

A still further example provides a kit for treatment of microbial, viral or fungal infections of tissue, in biofilm, saliva, skin, plaque, on teeth surfaces and in mucous membranes, comprising an optoelectronic device which simultaneously emits a first light consisting of high energy photons having majority energy between 3.17 eV to 2.95 eV and a second light consisting of low energy photons having a majority energy in the range from 1.4 eV to 1.6 eV, said first and said second light amounting to at least 80 % of all light emitted from the optoelectronic component or device, and at least one photosensitizer which is activated by at least either of the high energy and low energy photons, wherein the photosensitizer is Indocyanine green.

More specifically, the present disclosure is characterized by what is stated in the independent claims.

Considerable advantages are obtained. The use of high and low energy photons to target endo- and exogenous molecules gives rise to a target molecule site specific treatment due to low life-time of reactive or high energized oxygen.

According to the disclosure the high energy photons are being absorbed by endogenous (intracellular) molecules to generate reactive oxygen singlets and reactive oxygen. Simultaneously low energy photons are being absorbed exogenously (extracellular) by the photo-sensitizer resulting in reactive oxygen singlets and reactive oxygen. The reactive oxygen singlets and reactive oxygen species will inactivate, kill and otherwise reduce micro-organisms such as bacteria, virus and fungus in tissue, biofilm, saliva, skin, plaque and teeth surface.

The treatment will achieve good tissue penetration. It makes it possible to give antibacterial treatment to different areas of pathogen at the same time as two or more different energy photons can target molecules in different areas. Different energy photons have also different tissue therapeutic and tissue stimulating effects. The combined high and low energy photons can affect bacterial communication as they might have deleterious effect in bacteriophages, which contain genetic material or other molecules. The light may also have effects in the production, formation or activating of such communicating molecules assessed as quorum sensing.

"Antimicrobial blue light", also referred to by the abbreviation "aBL", is light, typically in the wave length area of 400 nm to 470 nm, such as 400 nm to 430 nm or 405 to 470 nm, or 405 to 430 nm, that exhibits for example intrinsic antimicrobial effect without the involvement of exogenous photosensitizers.

"Photosensitizers" are compounds or molecules that are capable of absorbing electromagnetic radiation for example in the ultraviolet or visible region and transferring it to adjacent molecules. Typically, the photosensitizers have de-localized π systems.

Although the term "photosensitizer" at instances is used in the singular voice in the present context, the term also comprises several compounds or molecules. In particular it comprises mixtures or sequential use of two or more photosensitizer compounds or molecules. In case of using a plurality of photosensitizer compounds or molecules, at least one is suitable for use with high energy photons and at least one is suitable for use with low energy photons.

In one embodiment, one photosensitizer selected is capable of achieving endogenous antimicrobial action in combination with the corresponding light, and one photosensitizer is selected which is capable of achieving exogenous antimicrobial action in combination with the corresponding light.

The photosensitizers can be naturally occurring compounds ("natural photosensitizers") and synthetic compounds. Examples of natural photosensitizers include the following: Hypericin, curcumin, phenalenone derivatives, Cercosporin, psoralen, xanthotoxin, Angelicin, alpha-Terthienyl, Phenylthepatriyne, THC, Cannabidiol (CBD). Synthetic photosensitizers include the following: RB (Rose Bengal), Porphyrin derivatives, Curcumin derivatives, Methylene Blue, Indocynine Green, Erythosine, Phenalenone derivatives, Fullerene derivatives, Xanthene derivates, Resveratrol.

Other photosensitizers are represented by berry extracts, such as lingonberry and blueberry including polyphenolic compounds and/or anthocyanine compounds.

Claims

1. Use of a sensitizer in the manufacture of a medicament for the topical treatment of an infection on a mammal, wherein said sensitizer is to be applied to a part of skin or mucous membrane and said part is to be subsequently or simultaneously subjected to first photons with a majority energy between 2.95 eV and 3.17 eV; and second photons with a majority energy between 1.4 eV and 1.6 eV,

wherein said sensitizer comprises at least one photosensitizer selected from the group of natural compounds comprising hypericin, curcumin, Cercosporin, psoralen, xanthotoxin, Angelicin, alpha-Terthienyl, Phenylthepatriyne, THC, Cannabidiol (CBD) and combinations thereof, and the group of synthetic photosensitizers comprising RB (Rose Bengal), Methylene Blue, Indocyanine Green, Erythosine, resveratrol, berry extracts, such as lingonberry and blueberry including polyphenolic compounds and/or anthocyanine compounds and combinations thereof, or the photosensitizer being the combination of at least one photosensitizer is selected from the group of natural compounds listed above and at least one photosensitizer is selected from the group of synthetic compounds listed above.

2. The use according to claim 1, wherein the infection is a microbial, viral or fungal infection of tissue, in biofilm, saliva, skin, plaque, on teeth surfaces and mucous membrane.

3. The use according to claim 1 or 2 , wherein the photosensitizer is subjected to light energy, in particular non-coherent radiant light energy, at a first wavelength from 400 to 430 nm, preferably at a dosage of 1 to 120 J/cm^2, and in particular with a power density of from 10 to 2500 mW/cm^2 for a period of time from 0.5 s to 120 min, and at a second wavelength from 780 to 830 nm, preferably at a dosage of 1 to 120 J/cm^2, and in particular with a power density of from 10 to 2500 mW/cm^2 for a period of time from 0.5 s to 120 min.

4. The use according to any one of claims 1 to 3 wherein the part of skin or mucous membrane comprises a biofilm formed by *Streptococcus mutans*.

5. The use according to any one of claims 1 to 4, wherein the sensitizer is provided in a kit for treatment of microbial, viral or fungal infections of tissue, in biofilm, saliva, skin, plaque, on teeth surfaces and in mucous membranes, comprising an optoelectronic device which simultaneously emits a first light consisting of high energy photons having majority energy between 2.95eV and 3.17 eV and a second light consisting of low energy photons having a majority energy in the range from 1.4 eV to 1.6 eV, said first and said second light amounting to at least 80 % of all light emitted from the optoelectronic component or device, wherein the sensitizer is activated by at least either of the high energy and low energy photons, wherein the photosensitizer is Indocyanine green.

6. The use according to any one of claims 1 to 4, wherein the sensitizer is provided in a kit comprising an optoelectronic device which simultaneously emits high energy photons with majority energy between 2.95 eV and 3.17 eV and low energy photons with majority energy between 1.4 eV and 1.6 eV, together with Indocyanine green, for carrying out a method for achieving a sustained antimicrobial effect in preventive and curative dental/oral care for long term use.

7. The use according to any one of claims 1 to 4, wherein the sensitizer is provided in a kit according to claim 5 or 6, further comprising a sensor capable of monitoring treatment progression, said sensor in particular being capable of detecting treatment progression and of producing a regulation signal based on the progress of the treatment, said sensor being coupled to the optoelectronic device to adjust the light emitted from the optoelectronic device depending on the regulation signal.

8. The use according to any one of claims 1 to 4, wherein the sensitizer is provided in a kit according to any of claims 5 to 7, comprising an optoelectronic device exhibiting the shape of a tooth brush, or the shape of a mouth piece which can be inserted in a mouth between the biting surfaces of the teeth, or the shape of a rod like illuminator.

9. The use according to any one of claims 1 to 4, wherein the sensitizer is provided in a kit according to any of claims 5 to 8, wherein the optoelectronic device used comprises micro-spectrometer sensors, temperature sensors, light sensors, pH sensors, force sensors, gyroscopes, pressure sensors or combinations thereof.

10. The use according to any one of claims 1 to 4, wherein the sensitizer is provided in a kit according to any of claims 5 to 9, comprising a tooth whitening substance capable of being used with a dual wavelength light source or together with a photosensitizer.

11. The use according to any one of claims 1 to 4, wherein the sensitizer is provided in a kit according to any of claims 5 to 10, comprising a photosensitizer in form of water soluble effervescent tablet and further comprising a hand held light applicator which emits dual light photons.

12. The use according to any one of claims 1 to 4, wherein the sensitizer is provided in a kit according to any of claims 5 to 11, comprising a photosensitizer in the form of a water soluble effervescent tablet, gel, or paste, and further comprising a one-time use mouth piece and light applicator.

13. The use according to any one of claims 1 to 4, wherein the sensitizer is provided in a kit according to any of claims 5 to 12, comprising a photosensitizer in the form of photosensitizers incorporated or inherently present in berry extracted mouth rinse.

14. The use according to any one of claims 1 to 4, wherein the sensitizer is provided in ae kit according to any of claims 5 to 13, comprising hydrogen peroxide as a potentiating compound.

15. The use according to any one of claims 1 to 4, wherein the sensitizer is provided in a kit according to any of claims 5 to 14, wherein the optoelectronic device emits light, in particular non-coherent light, at a first wavelength from 400 to 430 nm, preferably at a dosage of 1 to 120 J/cm^2, and in particular with a power density of from 10 to 2500 mW/cm^2 for a period of time from 0.5 s to 120 min, and at a second wavelength from 780 to 830 nm, preferably at a dosage of 1 to 120 J/cm^2, and in particular with a power density of from 10 to 2500 mW/cm^2 for a period of time from 0.5 s to 120 min.

16. The use according to any one of claims 5 to 15, wherein the optoelectronic device comprising light-emitting diode(s) as a light source.