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NEW TECHNOLOGIES FOR COSMETIC APPLICATIONS

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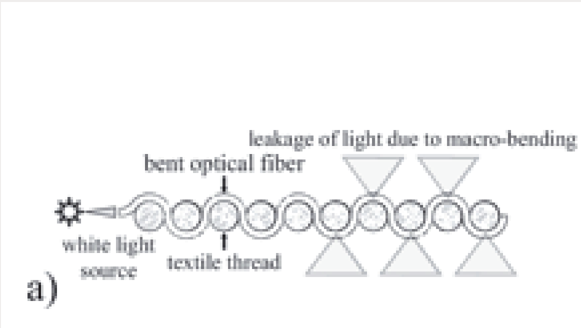
Light emitting fabrics for photodynamic therapy of skin

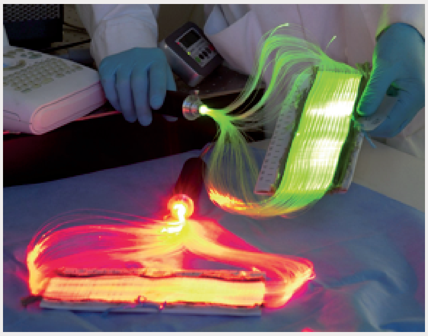
Background and Objectives : A homogeneous and reproducible fluence rate delivery during clinical PDT plays a determinant role in preventing under- or overtreatment. In Dermatology, topical PDT has been carried out with a wide variety of light sources delivering a broad range of light doses. However, these light sources do not deliver a uniform light distribution on the skin due to their structure and morphology and the complexities of the human anatomy. The development of a flexible light source able to generate uniform light on all its surface would considerably improve the homog neity of light delivery. The integration of plastic optical fibers (POF) into textile structures offers an interesting alternative. This study aims at the production of large, flexible and homogenous light emitting fabrics (LEF) based on POF weaving connected to laser sources. The homogeneous light side-emission from the fabric is obtained by controlling the bending angles of POF inside the LEF due to specific architecture generated by weaving of textile structures.

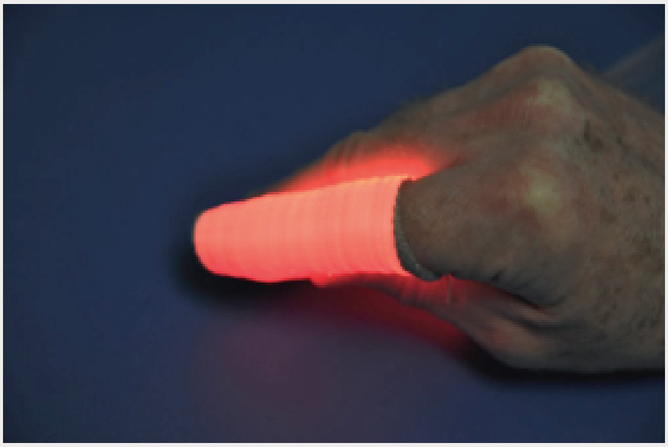
Materials & Methods : LEF has been developed using POF (250 µm, weft direction) and Polyester yarns (330 dtex, warp direction). POF macrobendings were predetermined to obtain side emission of light since the critical angles were exceeded in a controlled way. Therefore, a particular pattern based on different satin weaves has been developed in order to improve light emission homogeneity and to correct the decrease of side emitted light radiation intensity along POF. The prototype fabrics, with a density of 37 POF/cm, were woven using an automated loom. In order to overcome the decrease of side-emitted radiation intensity along the fabric and achieve homogeneous light all over the LEF surface, both POF bundled ends were coupled to diode lasers. Characteristics of this LEF were determined in terms of light emission, flexibility, etc…

Results : LEF of 21.5 cm × 5.0 cm (i.e. 107.5 cm^2) was woven. The LEF thickness is typically 1 mm. When connected to a 5 W diode laser (635nm), the average light emission is 18.2 mW.cm-^{2} (i.e. 3.64 mW.cm-^{2}.W-1) with heterogeneity of ± 2.5 mW.cm-^{2} (13.7 %) at any point of the LEF. The temperature elevation remains below 1°C for a 10 minutes illumination.

Conclusion : LEF meets the basic requirements for PDT: homogeneous light distribution and flexibility. It can be easily produced by automatic weaving and no post treatment of POF is required. LEF can be connected to any diode laser: 405 nm, 635 nm, 655 nm, etc… Large (500 cm^2), moreover LEF can be easily manufactured in large series and can be used on skin, but also in peritoneal or pleural cavities. They can be designed to perform PDT of actinic keratosis on scalp or woven as glove to treat onychomicosis.







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