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New dental applications with LEDs

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Abstract— Visible and ultraviolet LEDs will in the future give rise to new dental applications. Fluorescence imaging, photodynamic therapy and photoactivated disinfection are important future candidates for diagnostics and treatment in dentistry.

Keywords— LED; dentistry; optical diagnostics; bacteria.

INTRODUCTION

Development of new Light Emitting Diode (LED) technology considerably reduces the electricity consumption in many lighting applications [1]. Therefore, there is a rapid growth in lighting based on LEDs. In addition to the energy savings, however, LEDs have many potential medical applications that will be important in the future. Red, yellow, green, blue and ultraviolet colours can be obtained from LEDs that will give rise to applications within diagnostics and treatment of diseases. In this letter we will discuss how LEDs in the future may be used in dental applications.

SUMMARY

Today LEDs are used for general lighting and photo polymerization in dental clinics but the ability to design the colour composition of LEDs will in the future make it possible to improve the ability to visually identify plaque, veins and bacteria in the oral cavity. Recently, we provided empirical evidence [3] that specific colour design of white light LED illumination can affect the human ability to identify veins. Narrow band imaging with LED enhances images of capillaries in the surface layers of the human tissue. Blue (390-440nm) for surface vessels and green (525 nm 550 nm) for deeper vessels. Therefore, medical doctors and dentists have a new tool for probing changes in capillaries and



Fig. 1. Blue light in the tooth

veins. White light LED sources based on color mixing is superior to fluorescent light for detection of inflamed lesion in the oral cavity [4-5]. Light induced fluorescence using blue LEDs is a clinical tool for diagnostics of tumours and bacteria. In combination with a photosensitizer the light may lead to cell necrosis and the procedure is used in photodynamic therapy or disinfection of bacteria in the dental root canal.

UV-LED is a new LED light source that may be used for disinfection without the need for a photosensitizer. At DTU Fotonik we work on the development of UV-LEDs that are optimised for disinfections of specific bacteria [5]. We have shown that for bacteria in biofilms specific wavelengths in the UV B region are more effective than UV C for killing bacteria[6-7]. Furthermore, the UV B wavelength that is found effective for killing bacteria in biofilm, is part of the wavelength that exists in daylight. This gives new possibilities for applications within oral disinfections. In the talk we will discuss the latest results of the efficiencies of killing bacteria using UV-LEDs and how these light sources potentially may be used to kill bacteria in the tooth root canal and also for the treatment of periodontitis.

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