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LED Technology for Dental Applications

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Abstract

LEDs have a large potential in many dental and oral applications. Areas such as photo polymerization, fluorescence imaging, photodynamic therapy, and photoactivated disinfection are important future candidates for LED based diagnostics and treatment in dentistry.

Introduction

Light Emitting Diode (LED) technology offers high light quality and considerable energy savings in many lighting applications [1]. Therefore, there is a rapid growth in lighting based on LEDs within application areas such as lighting, head lights for cars, mobile phones, and flat panel screens. However, in addition to the energy savings, LEDs show a great potential in many medical applications in the future. In this paper, we will discuss how LEDs in the future may be used in dental applications.

Applications of LEDs in Dentistry

In dental clinics, LEDs today are mainly used for general lighting and photo polymerization. Especially, the introduction of LEDs for photo polymerization has been one of the important milestones in dentistry. Composite resin based materials are attractive in dentistry because they have a tooth-like appearance and because they can be successfully bound to the tooth structure. The photo polymerization in these materials is initiated by blue or UV light. The basic mechanism for photo polymerization is that monomers with photosensitive materials are converted into polymers when illuminated. Light curing units have been based on quartz tungsten halogen, plasma arc lamps, or lasers but today almost all these light sources have been replaced by LED technology. It was the development of high brightness LEDs based on InGaN/AlGaIn in 1994 [2] that paved the way for LED technology into the dental clinics.

Due to the introduction of LEDs in dentistry, significant improvements in tooth restoration and dental filling have occurred. The advantages of the LED based photo polymerization technology are that the dentist has sufficient working time during the restoration work, and at

the same time very fast curing of the material. Furthermore, the filling material has improved strength and shows excellent color stability.

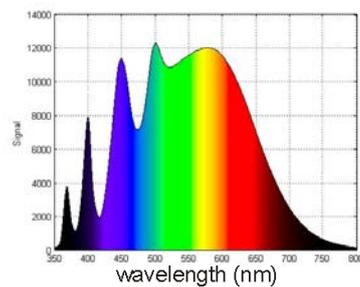


Figure 1. The UV, visible, and infrared spectrum of the LED light sources will give new dental applications in the future

Figure 1 shows a spectrum of a LED light source. The UV, visible and infrared spectrum of the LED light source will in the future give new dental applications within identification of plaque, veins, and bacteria in the oral cavity. Blue and visible white light LED sources may be used for improved visualization of capillaries, bacteria, and for detection of inflamed lesions in the oral cavity [3-5]. LEDs in combination with photosensitizers can be used for fluorescence diagnostics and for photodynamic therapy. These methods may be used for diagnostics and disinfection of bacteria in the dental root canal.

Ultraviolet emitters based on UVA and UVB LEDs are new LED light sources that may be used for disinfection without the need for a photosensitizer. Recently, we have worked on the development of UV-LEDs that are optimised for disinfection of specific bacteria [6]. These results offer new possibilities for applications within dental applications related to treatments of periodontitis and infections in the dental root canal.

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