Development of a phosphor material for application in luminescent solar concentrators

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In the field of photovoltaics, a luminescent solar concentrator (LSC) refers to a device that is used as a large area solar radiation collector, which then converts and emits radiation and directs it to solar cells that are located at the small side area of the LSC. However, a transparent luminescent solar concentrator (TLSC) is a new approach for collecting only solar radiation that is invisible to the human eye and utilizing it for energy generation as illustrated in Figure 1. This approach is an attractive solution to address the energy demands of buildings and mobile electronics without affecting their appearance [1]. As illustrated in Figure 1 the basic design of TLSC is a luminescent material that is embedded into a transparent waveguide. A portion of the solar spectrum is absorbed by the luminescent material and this energy is then emitted at a different wavelength. Some of this emitted radiation is then trapped inside the waveguide due to internal reflection and is directed towards the edges of the TLSC where the energy can be converted into electric power by the use of solar cells [1].

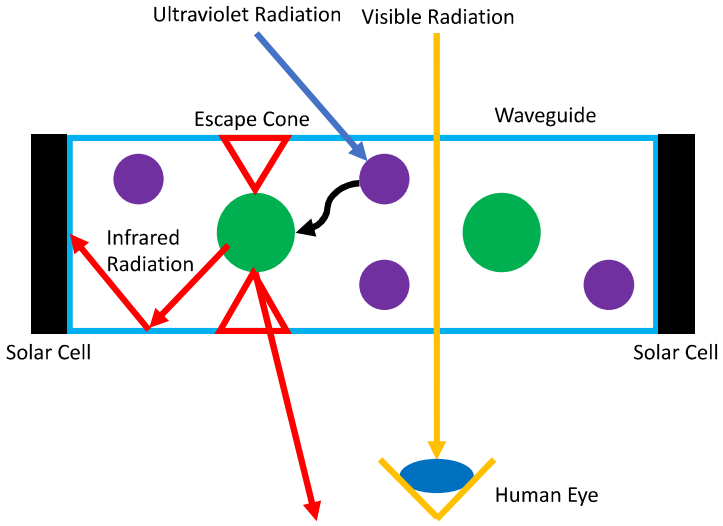

Fig. 1: Schematic explaining the basic principle of a TLSC. Radiation from the visible region passes through the material without being absorbed, while radiation from the ultraviolet region is absorbed by the material. This energy is then transferred, down converted/shifted and emitted in the infrared region. Some of this radiation is guided towards the edges of the material where solar cells are used for energy conversion while some of the radiation is lost through the escape cones.

In order to maximize the overall power conversion efficiency of an TLSC device there are challenges that need to be addressed. These include the reflection from the front of the waveguide, the spectrum absorption efficiency of the luminescent material, the quantum efficiency of the luminescent material, the waveguide's efficiency to trap emitted photons and the ability of the luminescent material to suppress reabsorption [1]. All these parameters must

th doped phosphor ands (5-20 nm) and the inorganic hosts, which are more chemically- and photo-stable than their organic counterparts [2]. Another important criterium is that there must be a complete spectral separation between emission and absorption bands of the phosphor material. In this contribution a suitable rare earth doped phosphor material was identified and the results for the synthesis process of this material will be given.

References

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