Multi-functionality of Luminescent Glasses for Energy Applications

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Luminescent glasses gain increasing importance in optical devices, such as fibre lasers or light emitting diodes. In this work, series of rare-earth doped glasses are investigated for their potential application as photon converters for photovoltaic (PV) and solid state lighting (SSL) applications.

Solar modules have a poor response in the blue and near ultraviolet (UV) spectral range due to thermalization losses and absorption in the cover glass and the front contact layer. To overcome this problem, luminescent glasses are used as cover, which down-shift the incident blue and UV photons to photons of a wavelength more effectively absorbed by the solar cell. Apart from photon down-shifting, rare-earth doped glasses can also be used for photon up-conversion, where a high-energy photon is emitted after sequential absorption of two (or more) low-energy photons. Here, a practical application is in concentrated PV systems where the efficiency can be further improved by using an up-converting layer on the backside to up-convert the far-infrared photons to a more suitable wavelength in the near infrared or even in the visible spectral range.

In light emitting diode (LED) applications, luminescent glasses have the potential as encapsulating material for the generation of white light. There are two possibilities how white light can be produced by using commercial LEDs: In the early days of the LED lightning technology, white light was generated by the primary colours red, green and blue. Another possibility can be achieved with a phosphor or a luminescent glass, which converts a part of the blue light from the LED into yellow light. Mixing the two complementary colours blue and yellow in the correct ratio yields to the emission of white light.