Tb^{3+} / Yb^{3+} doped aluminosilicate phosphors for visible emission and efficient up-conversion

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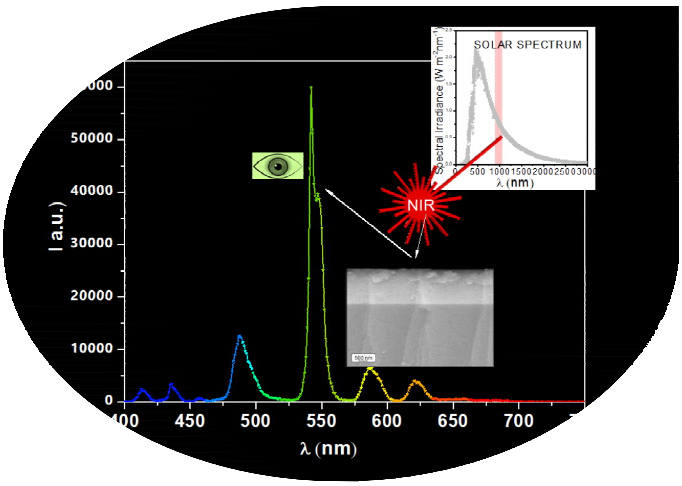
ABSTRACT

Conventional energy sources have severe drawbacks in terms of environmental pollution and limited availability. Therefore, the solar energy market-has been growing quickly in the last decades, but one of the challenges is to increase the efficiency of solar photovoltaic technologies. Different paths have been followed, including the matching of the solar spectrum with the solar cell spectral efficiency through down-conversion and up-conversion (UC) processes. In particular, UC is a promising route to solve the transparency losses of sub-bandgap photons [1]. With the incorporation of UC material, transmitted sub-bandgap photons can be converted into above-bandgap light which is absorbed by the cell material. To date, Ho^{3+}/Yb^{3+}, Er^{3+}/Yb^{3+} and Tm^{3+}/Yb^{3+} emitter/absorber pairs have been widely employed together with 980 nm laser excitation. Tb^{3+} is another candidate for emitter ion, since it exhibits ultraviolet, violet, blue, green, yellow and red emissions and has much longer luminescence lifetime than Ho^{3+}, Er^{3+} and Tm^{3+} [2]. Therefore, the Tb^{3+}/Yb^{3+} pair is also a potential choice for UC applications. While Ln-doped luminescent layers may be deposited by methods like CVD or PVD, sol-gel (SG) processing is a low-cost technology which can be a versatile and scalable alternative. This technique has the added advantage that it can easily be coupled with the deposition of multilayered 1-D photonic crystal (PC) structures like Bragg Mirrors (BMs) and microcavities (MCs) in order to integrate the spectral conversion function into a more efficient photonic structure. In the present work, we report the synthesis of Tb^{3+}/Yb^{3+} co-doped aluminosilicate glass films and MC structures by SG. Efficient blue (~ 488 nm), green (542 nm) orange (585 nm) and red (~ 621 nm) UC emissions have been demonstrated with excitation in the NIR at 975 nm. The phosphor layers studied in this work represent a valuable and promising approach for the preparation of efficient UC coatings to be integrated in solar cell and optoelectronic technologies.



Bibliography

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