Luminescence properties of nanocrystalline TiO_2:Nd,Yb

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Titanium oxide (TiO_2) due to its non-linear optical behavior, low cost, non toxicity and good biocompatibility is applicable as an active material for biomedical and photonic applications like luminescent markers and photovoltaic converters [1-3]. Due to its properties like large band gap and low phonon frequencies, this oxide (as well as ZrO_2 [4] and HfO_2 [5]) is an efficient host material for rare earth ions with $4f^n$ electron configuration [6].

This work reports the sol-gel synthesis and luminescent properties of TiO_2 co-doped by Yb and Nd. Neodymium has been chosen as dopant because of its high absorption due to 4f electron transition [7]. The Yb and Nd dopants are proposed in order to improve the spectral response of photovoltaic converters to both long- and short-wavelength light, due to up-conversion and down-conversion mechanisms.

The structural properties of the nanopowders were investigated using X-ray diffraction and transmission electron microscopy. The luminescence results obtained for TiO_2:Yb,Nd nanopowders show that co-doping with Nd^{3+} ions allows for broadening of the near-IR emission by the 1078 nm line and its satellites that possibly may be also useful for the solar spectrum modification. Moreover, the excitation spectrum for the Yb^{3+} emission in this case consists also of several complex lines around 435, 475 and 530 nm caused by f-f transitions of Nd^{3+} ions demonstrating the excitation energy transfer between Nd^{3+} and Yb^{3+} ions. On the base of luminescence study, in the range of temperature from 4.5 K to 350 K, various excitation mechanisms were revealed and discussed. The influence of preparation conditions as well as microstructure of selected TiO_2 doped with Nd^{3+} -Yb^{3+} samples on luminescence is discussed.

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