LASER-EXCITED EXCITONIC LUMINESCENCE OF NANOCRYSTALLINE TiO_2 POWDER

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S u m m a r y

Titanium dioxide (TiO_2) nanocrystalline powders were prepared by the thermal hydrolysis method in the form of pure anatase or rutile and were investigated by X-ray diffraction, X-ray fluorescence, FT-Raman spectroscopy, optical absorption, and photoluminescence (PL) methods. PL spectra were studied under the intense UV laser excitation at 337.1 nm (3.68 eV) at room temperature. Some interesting features in the PL spectra including the well-resolved peaks of excitonic and band-band transitions in TiO_2 were observed for the first time. It is shown that PL bands with peaks at 2.71–2.81 eV and its phonon replicas in anatase and rutile TiO_2 arise from the excitonic $e^- - h^+$ recombination via oxygen vacancies. The excitonic peak at 2.91 eV is attributed to the recombination of self-trapped excitons in anatase or free excitons in rutile TiO_2. The PL peaks within 3.0–3.3 eV in anatase TiO_2 are ascribed to indirect allowed transitions due to the band-band $e^- - h^+$ recombination. The peaks at 3.03 and 3.26 eV are attributed to the free exciton emission near the fundamental band edge of rutile and anatase TiO_2, respectively.