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Role of defects in the emission of undoped and doped ZnO thin film prepared by pulsed laser deposition

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Abstract content
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Undoped and doped zinc oxide (ZnO) thin films were grown by the pulsed laser deposition (PLD) technique on silicon (Si) substrate at different growth conditions. According to the x-ray diffraction patterns, all the ZnO films were oriented along the (002) plane. This is in line with the characteristics of the hexagonal wurtzite ZnO structure where the c-axis is perpendicular to the substrate plane. Generally, ZnO have two emissions, the near-band edge emission and the deep level emission. The strong near-band edge emission at room temperature is due to free exciton recombination while the visible light emission is ascribed to the structural defects such as zinc vacancy (Vzn), oxygen vacancy (Vo), interstitial zinc (Zni), interstitial oxygen (Oi) and antisite oxygen (Ozn). The photoluminescence spectra of terbium doped ZnO (ZnO:Tb3+) thin films were characterized by three different types of transitions, the one was due to exciton recombination emission, the second was due to defect level emission and the third was due to the Tb3+ f-f transitions. The formation of different kind of defects in the ZnO was confirmed by X-ray photoelectron spectroscopy results. For the emission due to the Tb3+ ions, a major green emission peak at 543 nm and a few minor peaks at 489 and 622 nm were detected. These peaks represent the 5D4-7F5, 5D4-7F6, and 5D4-7F3 transitions of Tb3+, respectively. These ZnO thin films can be used as a suitable future light emitting material applications.

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