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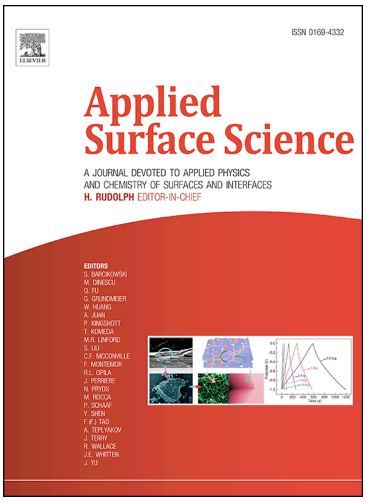

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Photocatalytic Degradation of Rhodamine-B Dye by Stable ZnO Nanostructures with Different Calcination Temperature Induced Defects

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Abstract:

For developing ZnO as an efficient photocatalyst it needs to embrace a suitable architecture to promote simultaneous maximum photon absorption and minimum charge carrier recombination. In this regard, presently ZnO nanoparticle and nanorod morphologies with embeded pit like structures possessing enriched surface defects, as demonstrated by X-ray diffraction as well as electron microscopic studies, have been prepared using a rapid one-pot co-precipitation technique. Further characterization by electron paramagnetic resonance (EPR), Raman and PL spectroscopy reveal the origin of bulk and surface defects within the nanostructures. Prominent EPR signals with different g-factors e.g., g= 1.93, 1.97, 2.01 etc., indicate EPR-active defect regions on the bulk and surface of the material. These defect states lower the fast recombination of electron and hole, increase charge transport and accelerate the photocatalytic activity. In the present study most efficient ZnO nanostructures have been obtained at calcination temperature (T_C) ~500 °C. Formation of metallic zinc through surface reduction of Zn^{2+} centers promotes narrowing of the optical band gap and endorses efficient absorption of light, additionally via enhanced surface area of the pitted structures. These surface defects reduce recombination of the photogenerated charge carriers and enhance photo-degradation efficiency to ~97.75% and rate constant to ~0.042 min^{-1} under the exposure of UV light.

Keywords: ZnO nanostructures; Pitted structure; Metallic zinc; Oxygen vacancy; Photocatalytic activity

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