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Oxygen-defective ZnO films with various nanostructures prepared via a rapid one-step process and corresponding photocatalytic degradation applications

Zexin Yu^{a*}, Hatem Moussa^b, Yangzhou Ma^c, Meimei Liu^a, Bilel Chouchene^b, Raphaël Schneider^{b*}, Michel Moliere^a, Hanlin Liao^a

^aICB-LERMPS UMR 6303, CNRS, UTBM, Université de Bourgogne Franche-Comté, 90010 Belfort, France. Email : zexin.yu@utbm.fr

^bUniversité de Lorraine, Laboratoire Réactions et Génie des Procédés (LRGP), UMR 7274, CNRS, 54001 Nancy Cedex, France. Email : raphael.schneider@univ-lorraine.fr

^c School of Materials Science and Engineering, Anhui University of Technology, Ma'anshan 243002, P.R.China.

* Corresponding author. E-mail address: zexin.yu@utbm.fr (Zexin Yu), raphael.schneider@univ-lorraine.fr (Raphaël Schneider).

The deposition of oxygen-defective ZnO films exhibiting varied nanostructures via Solution Precursor Plasma Spray (SPPS) route, a one-step, minute-scaled duration and large scale method, is reported. The *in situ* formation of oxygen vacancies in ZnO films was confirmed by UV-Visible, Raman and photoluminescence (PL) spectroscopy and the as-prepared samples exhibit a bandgap as low as 3.02 eV. Density functional theory (DFT) simulation demonstrates that the polarization of ZnO is enhanced by the created oxygen vacancies, leading to substantially improved photocatalytic activity. The comparative experiments also revealed that forming and preserving appropriate ZnO precursor clusters inside the plasma plume is requisite for obtaining propitious ZnO nanostructures, which was followed by the *in situ* transfer and growth of the clusters on the preheated substrate. The ZnO-NRs films fully degrade the aqueous Orange II dye solutions dosed at a concentration of 10 mg/L within 120 min and maintain a quasi-intact activity (95.8% retention) after five test runs, which highlight

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