

RSC Advances

Resin-gel incorporation of high concentrations of W⁶⁺ and Zn²⁺ into TiO₂-anatase crystal to form quaternary mixed-metal oxides: Effect on the a lattice parameter and photodegradation efficiency

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Abstract

The search for a viable photocatalyst for water remediation is ongoing and in recent times the efforts have predominantly focused on improving the limitations of the TiO₂ photocatalyst. This paper reports a dual strategy for improving the photocatalytic properties of TiO₂. The first strategy is to dope up to 30% of W⁶⁺ and Zn²⁺ into the crystal lattice of TiO₂ using the resin gel technique to synthesize quaternary mixed metal oxides (QMMOs). It was demonstrated by laser Raman spectroscopy, PXRD and various other strategies, including dislodging the dopants from the crystal lattice of TiO₂, that these materials were successfully synthesized. More importantly, UV-DRS showed that these materials could absorb visible light. TiO₂ and the QMMOs were also supported on 10% NCNTs synthesized from coal fly ash, by slightly modifying the resin gel technique. It was observed from TEM images that the NCNTs were uniformly coated with TiO₂ and QMMO nanoparticles. These composites were observed to have lower photoluminescence emission spectra when compared to neat TiO₂ and unsupported QMMOs. The two-part strategy employed in this project worked as the QMMOs supported on 10% NCNTs had higher visible light photodegradation efficiencies compared to neat TiO₂ and the unsupported QMMOs.