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Aslam, M., Qamar, M.T., Soomro, M.T., Ismail, I.M.I., Rehan, Z.A., Ashraf, M.W., Hameed, A.

The effect of cerium alteration on the photocatalytic performance of WO3 in sunlight exposure for water decontamination
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Abstract
In an effort to enhance the photocatalytic activity of cubic WO3 in sunlight exposure, its surface was modified by impregnating the Ce3+ ions ranging from 1% to 25% with a step of 5% with respect to the weight of WO3. Compared to pure WO3, the optical analysis by diffuse reflectance spectroscopy (DRS) revealed better absorption cross-section and red shift in the band edges for Ce loaded catalysts. The decreased intensity of photoluminescence (PL) emissions and the suppression of the Raman active bands of WO3 verified the recombination quenching ability of Ce surface states. The XRD analysis revealed the existence of Ce3+ states in the lower loadings (≤5%), whereas the majority of Ce4+ states were noticed at higher loadings. The FESEM analysis also verified the formation of individual particles of Ce(iii,iv) oxides at the surface of WO3 at higher loadings. The XPS analysis of 10% Ce loaded samples also revealed the presence of mixed oxides of Ce at higher loading. Except for 1% Ce loaded WO3, the estimation of charge-discharge capacity, in comparison to pure WO3, revealed the enhancement in the charge retention ability with the increasing Ce loading. In comparison to pure WO3, the synthesized catalysts exhibited superior activity for the removal of 2-nitrophenol and 2-chlorophenol substrates in natural sunlight exposure. The analysis of the degradation data revealed that in the lower concentration the surface oxygen bonded Ce3+ states serve as electron trapping and transfer centers, whereas with the increasing surface density the synergic composite mechanism is the dominating mode. The exaggerated estimation in the EDX analysis of the samples loaded with 15% and 20% Ce also revealed the major surface coverage by the oxides. The salient feature of the study was the evaluation of the photocatalytic activity with the minimal catalyst loading of 350 mg L-1. © 2016 The Royal Society of Chemistry.

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