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Optimization of Visible Degradation Efficiency of Toxic Organic Contaminant Using Hybrid Photocatalysts based on TiO_2 †

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Abstract: The development of active semiconductor photocatalysts with desirable material properties and efficient carrier transformation is indispensable for better photocatalyst utilization and performance optimization. Here, Salicylic acid-modified dysprosium doped TiO_2 (TNP-Dy/AS) complex materials were firstly synthesized via modified sol–gel followed by impregnation method.

The developed TNP- Dy material had a well-designed nanostructure, in which the TiO_2 nanoparticles (TNP) and Dy materials were closely bounded with each other. The salicylic acid complexes fixed on the TNP surface which were confirmed by TEM and SEM, thus improving the surface area and subsequently charge separation. Innovatively merged photocatalysts of salicylic acid (AS) complexes with TNP-Dy were successfully verified for photocatalytic mineralization of organic contaminant under the visible light degradation.

As compared to original TNP-Dy, TNP-Dy/AS showed prominent improvement in the catalytic actions. Kinetics i.e., K_{app}, and R^2 (linear regression co-efficient) were also studied. The amended materials created charge separation, by means of electrons gathering at the higher CB, and holes gathering at the lower level valence band of the complex, therefore improving mineralization efficiency of the electrons and holes.

To be effective in photocatalysis application, the TiO_2 complexes should be stable during photocatalysis and does not undergo self-degradation. The TNP-Dy/AS and TNP/SA samples were irradiated 120 min and 240 min in water, separated and then dried without any heat treatment. After irradiation time (120 min), SA bands decrease slightly in intensity, while the (–COOTi–) band centered at 1386 cm^{-1} has shifted gradually, ultimately reaching 1360 cm^{-1} with a shoulder at 1395 cm^{-1}. The results confirms that the coordination in TNP-Dy/AS is stronger compared to TNP/SA , leading to excellent chemical stability.

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