“Nanocomposites and nanomaterials”

Design and fabrication of titanium dioxide inverse opals doped with silver nanoparticles for photocatalytic applications

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The development of titanium dioxide inverse opals (IO) has attracted a great deal of attention during the last few decades. The special, high-ordered macroporous structure induces larger surface area, multiple light harvesting and slow photon effect, which exhibit a great potencial in enhancing the photocatalytic degradation of pollutants. Changing the pore size of TiO_2 IO enables the modulation of light propagation in the material. [1] An additional method to enhance the photocatalytic properties of TiO_2 IO is their modification with silver nanoparticles (AgNPs). Interactions of metallic centers with semiconductor provides boosting of electron and hole lifetime. The combination of properties exhibited by inverse opal structure and AgNPs ensures tuning of the optical and electronic properties of TiO_2. The main challenge in this investigation remains achieving enhanced photocatalytic activity due to the expected synergistic effect between AgNPs and IO structure. TiO_2 IO coatings were prepared via sol-gel method using self-assembly of polystyrene (PS) colloidal crystal template. Polymer matrices in the form of PS microspheres obtained by emulsion polymerization was deposited on a silicon substrates as a thin layers. In a further step, the sol-gel method in which the precursor molecules form the inorganic TiO_2 skeleton around the matrix, was used. After removing by calcination the polymer matrice, TiO_2 inverse opal structure was obtained. AgNPs were grown on the surface of TiO_2 IO by the photoreduction of Ag^+ ions under UV illumination. The results of Rhodamine B photodegradation measurement revealed the enhancement of photocatalytic properties of AgNPs/TiO_2 IO in comparison with solid, undoped TiO_2.

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