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Highly Efficient Silver Modified Srtio$_3$ Photocatalyst: Synergistic Effect of Ag Doping and Ag Decoration

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Extended Abstract

Nitrogen oxides (NO and NO_2) are primary pollutants directly linked to respiratory diseases and environmental disasters such as acid rain and photochemical smog [1]. As a result, multiple techniques are used for their abatement. Among them, photocatalysis offers a cost-effective, green, and sustainable technology for air purification. This technology works at ambient condition, exploits the natural or artificial light, and uses semiconductors as photocatalysts to carry out the decomposition of inorganic pollutants on the surface of the material [2]. Over the last few years, perovskite-based materials have been considered as promising candidates for water splitting and water treatment applications [3]. However, their photocatalytic performance for indoor air pollution is scarcely examined. Strontium titanate ($SrTiO_3$) is a cubic-like perovskite with a wide energy band gap (3.2 eV) similar to TiO_2. Its chemical, thermal stability, and corrosion resistance make it more attractive for developing advanced thermally stable materials. Nevertheless, its light absorption is limited to the UV spectrum range [4]. For this reason, as for TiO_2, proper modifications are required, including metal-doping or metal-decoration. In the former, new energy levels are created leading to energy band gap narrowing, whereas the later improves the charge carrier separation through the semiconductor interface. Both strategies impact significantly the final photocatalytic properties of the material [5].

The work aims at the rational designing of Ag-modified $SrTiO_3$ composite for extending its photocatalytic efficiency towards the degradation of NO_x under LED light by using some strategies such as doping and decoration. A preliminary study demonstrated that the 5 wt.% Ag-decorated $SrTiO_3$ achieved nearly 77% NO_x removal after 3h. Whilst, through an eco-friendly, simpler, and valuable one-pot synthesis $SrTiO_3$ was doubly modified by Ag^+-doping within the $SrTiO_3$ lattice and by Ag nanoparticles-decoration on the $SrTiO_3$ surface. These modifications were confirmed by the XRD technique, where a slight shift towards the higher angles and the presence of additional peaks corresponding to metallic silver could be observed. The synergistic effect between Ag doping and Ag decoration contributed to the complete photodegradation of NO_x under LED light after 180 min, reaching a photocatalytic efficiency almost 4 times greater than bare $SrTiO_3$ (26%). The stability of the best material was assessed by performing recycling tests.

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