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Acid Orange 7 photodegradation at Ni-foam/Sr1-x(La,Bi)xTiO3

Strontium titanate ($SrTiO_3$) belongs to the perovskite family of compounds and is a very well-known oxide with high catalytic activity and high chemical and photochemical stabilities. In this research, we aimed to improve the $SrTiO_3$ photocatalytic activity through A-site cation doping.

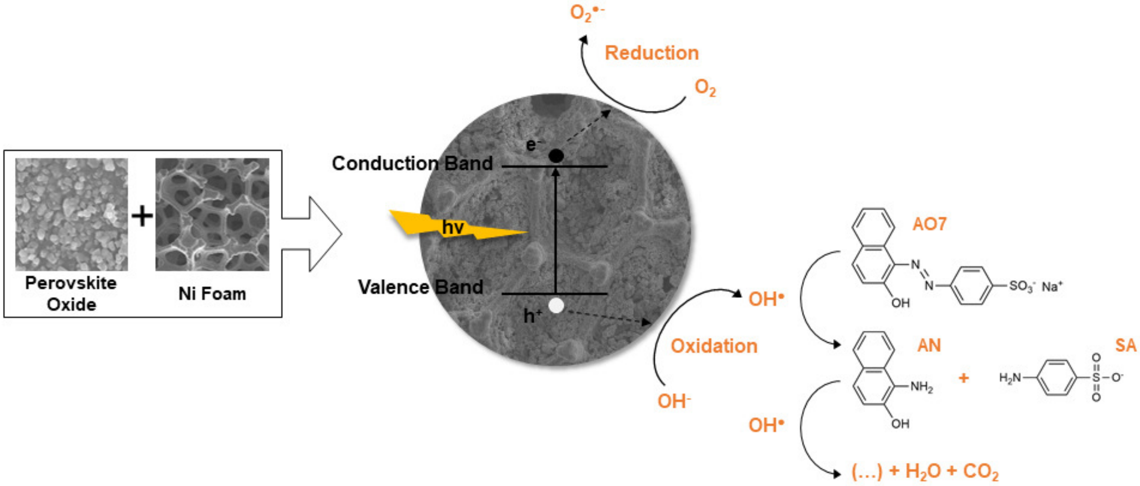

Fig. 1.

Lanthanum and bismuth were both chosen as A-cation doping elements in the $SrTiO_3$ structure. The mixed oxides were synthesized via solid state reaction at high temperatures (≥750ºC) with the following cationic proportions: $Sr_{1-x}La_xTiO_3$ ($0 \leq x \leq 0.4$) and $Sr_{1-x}Bi_xTiO_3$ ($0 \leq x \leq 0.3$). The synthesized powders structure and morphology were characterized by X-ray powder diffraction (XRD) and scanning electron microscopy (SEM), respectively. The XRD data revealed the presence of a predominant well-crystalized phase, belonging to the cubic perovskite in a Pm3m space group, for all synthesized samples. The occurrence of other minority phases was reported for both cationic substitutions, with $x \geq 0.1$. SEM results demonstrated that the average grain size was relatively smaller for the Bi-doped $SrTiO_3$ when compared with de La-doped oxides.

Considering that powder recovering is one of the associated difficulties within the application of these type of catalysts, all synthesized oxides were immobilized on nickel foam. These oxide films were then tested in the photocatalytic degradation of Acid Orange 7 (AO7) dye, under UV light (254 nm). The dye degradation was monitored by UV-Vis absorption spectrophotometry.

The AO7 UV-Vis absorption spectrum has three characteristic bands, two in the UV region, at 220 nm and 310 nm, and a strong absorption band in the visible region, at 484 nm. The UV bands are associated to the aromatic rings and the visible region band to the conjugated double bonds system. To assess the dye degradation, both 310 nm and 484 nm bands were monitored during the 5-hour assays.

For all tested oxides, the absorbance removal at 310 nm was always lower than at 484 nm, since the opening of the aromatic rings is more difficult than the breakage of the azo bond. This lower decay can also be linked to the formation of naphthalene-type degradation products, that given to their structure would absorb at 310 nm. The photocatalytic results showed an improvement in the photocatalytic activity correlated to the increase in the degree of substitution of strontium by La or Bi. The only exception is the $Sr_{0.9}Bi_{0.1}TiO_3$ oxide, where the highest AO7 degradation value was obtained, associated with the presence of the secondary phase, $Bi_4Ti_3O_{12}$.

In conclusion, the doping of $SrTiO_3$, with both cations, demonstrated an ability to improve the oxide photocatalytic activity on the degradation of AO7, under UV light.

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Publication

Preparation, characterization and environmental applications of Sr1 – x (La,Bi) x TiO3 perovskites immobilized on Ni-foam: photodegradation of the Acid Orange 7.
Nunes MJ, Lopes A, Pacheco MJ, Ciríaco L
Environ Sci Pollut Res Int. 2017 Apr