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Enhanced photocatalytic activity of La^{3+} and Se^{4+} co-doped bismuth ferrites nanostructures

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Photocatalysis is attracting huge interest by addressing current energy and environmental issues by converting solar light into chemical energy. For this purpose, we investigated the effect of La^{3+} and Se^{4+} co-doping on photocatalytic activity of $BiFeO_3$. The $BiFeO_3$ and $Bi_{0.92}La_{0.08}FeO_3$ nanoparticles containing different Se^{4+} doping contents ($BiFe_{(1-x)}Se_xO_3$,x= 0.0, 0.02, 0.05) and ($Bi_{0.92}La_{0.08}Fe_{(1-x)}Se_xO_3$, x = 0.0, 0.02, 0.05, 0.075, 0.1), respectively, were synthesized with double solvent sol-gel route. The co-doped nanoparticles were characterized by X-ray diffractometry (XRD), field emission scanning electron microscopy (FESEM), high resolution transmission electron microscopy (HRTEM), and UV-Vis diffuse reflectance spectroscopy (DRS), and their photocatalytic activity was studied by photocatalytic degradation of Congo red (CR) in aqueous solution under different wavelengths of light illumination. The band-gap of the pure $BiFeO_3$ was significantly decreased from 2.06 eV to 1.94 eV. It was found that the La^{3+} and Se^{4+} co-doping significantly affected the photocatalytic performance of pure $BiFeO_3$. Moreover, with the increment of Se^{4+} doping into $Bi_{0.92}La_{0.08}FeO_3$ up to an optimal value, the photocatalytic activity was maximized. In order to study the photosensitization process, photo-degradation of colorless organic compound (acetophenone) was also observed. On the basis of these experimental results, the enhanced photocatalytic activities of La^{3+} and Se^{4+} co-doping could be attributed to the increased optical absorption, the efficient separation and migration of photo-generated charge carriers with the decreased recombination of electron-hole resulting from co-doping effect. The possible photocatalytic mechanism of La^{3+} and Se^{4+} co-doped $BiFeO_3$ was critically discussed

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