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Investigation of Structural and Optical Properties of Coal Fly Ash Thin Film Doped with T□O₂ Nanoparticles

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Abstract : For environmentally friendly innovative technologies and a sustainable future, fly ash/TiO_2 thin film nanocomposites are essential. Fly ash will be doped with titanium dioxide in this work in order to better understand its optical characteristics and employ it in semiconductor electrical devices. This study focused on the structure, morphology, and optical properties of fly ash/TiO_2 thin films. The spin-coating technique was used to create thin coatings of fly ash/TiO_2. For the first time, the doping of TiO_2 in the fly ash host at ratios of 1, 2, and 3 wt% was investigated with the thickness of all samples fixed. When compared to undoped thin films, the surface morphology of the doped thin films was improved. The weakly crystalline structure of the doped fly ash films was verified by XRD. The optical bandgap energy of these films was successfully reduced by the TiO_2 doping, going from 3.9 to 3.5 eV. With increasing dopant concentration, the value of Urbach energy is increasing. The optical band gap is clearly in opposition to the disorder. While it considerably improved the optical conductivity to a value of 4.1 x 10^9 s^(-1), it also raised the refractive index and extinction coefficient. Depending on the TiO_2 doping ratio, the transmittance decreased, and the reflection increased. As the TiO_2 concentration rises, the absorption of photon energy rises, and the absorption coefficient of photon energy is reduced. results in their possible use as solar energy and semiconductor materials.

Keywords : fly ash, structural analysis, optical properties, morphology
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