

Synthesis and characterization of ZnO-SiO₂ composite using oil palm empty fruit bunch as a potential silica source

ABSTRACT

In this paper, the structural and optical properties of ZnO-SiO₂-based ceramics fabricated from oil palm empty fruit bunch (OPEFB) were investigated. The OPEFB waste was burned at 600, 700 and 800 °C to form palm ash and was then treated with sulfuric acid to extract silica from the ash. X-ray fluorescence (XRF) and X-ray diffraction (XRD) analyses confirmed the existence of SiO₂ in the sample. Field emission scanning electron microscopy (FESEM) showed that the particles displayed an irregular shape and became finer after leaching. Then, the solid-state method was used to produce the ZnO-SiO₂ composite and the samples were sintered at 600, 800, 1000, 1200 and 1400 °C. The XRD peaks of the Zn₂SiO₄ showed high intensity, which indicated high crystallinity of the composite. FESEM images proved that the grain boundaries were larger as the temperature increased. Upon obtaining the absorbance spectrum from ultraviolet–visible (UV–Vis) spectroscopy, the energy band gaps obtained were 3.192, 3.202 and 3.214 eV at room temperature, 600 and 800 °C, respectively, and decreased to 3.127, 2.854 and 2.609 eV at 1000, 1200 and 1400 °C, respectively. OPEFB shows high potential as a silica source in producing promising optical materials.

Keyword: Oil palm empty fruit bunch; ZnO-SiO₂ nanocomposite; Silica; Structural; Optical