Synthesis and characterization of Zinc Silicate ceramic nanoparticles via sonochemistry

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Abstract

This study focuses on developing a sonochemical synthesis technique to produce high-purity willemite nanopowders. Initially, zinc silicate hydrate nanoparticles were synthesized using a modified sonochemistry approach, utilizing zinc salts and waterglass under pH-controlled conditions (pH 11–11.5) and Argon gas flow. Subsequently, the resulting precipitate underwent heat treatment at different temperatures. Characterization techniques including TGA/DSC, X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), dispersive X-ray spectrometry (EDX), and N_2 gas adsorption were employed to analyze phase transformations, morphological attributes, microstructures, and chemical composition.

The research revealed that a well-crystalline willemite monophase forms at 890 °C, as verified by XRD analysis. The synthesized material exhibited high homogeneity and exceptional purity, as evidenced by EDX elemental mapping. Microscopic assessments (SEM, TEM) further confirmed its nanoscale characteristics. Notably, this synthesis technique employs a moderate temperature, making it cost-effective for large-scale production and potentially valuable across various industrial sectors such as ceramics, paints, plastics, biomaterials, and composites.