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Pb₃O₄/ZrO₂ nanocomposite synthesized from single source molecular precursor employing sol gel method

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Lead Oxide and Zirconium Oxide are well known for their catalytic applications. However, the individual oxides have shown many deficiencies which could be hindered successfully by adding up them together. The coupling of dissimilar oxide introduces novel characteristics to the fascinating parameters of the individual oxides. However, the enhanced characteristics could only be achieved if the microstructure is controlled at atomic level. To do so, the role of precursor is very important. Therefore, a single source molecular precursor (SSP) is designed and developed for the synthesis of lead oxide/zirconium oxide nanocomposite. The heterometal-pseudo-alkoxide, [(bpy)Cl₂Pb(μ-OtBu)₂ZrCl₂(THF)₂], SSP was synthesized under nitrogen environment and structurally characterized by ¹H-NMR and IR spectroscopy. The thermal decomposition pattern of the SSP was established by TGA analysis.

The structurally characterized SSP was hydrolyzed at pH = 9 (employing sol-gel method) and the resulting powder were sintered at 450°C for 4 hours. The XRD pattern of the hydrolyzed product gives no significant peaks indicating that the material is amorphous. However, the crystallinity is improved upon sintering and significant peaks are observed in the XRD pattern of post-sintering sample corresponding to that of lead oxide ((Pb₃O₄)) and ZrO₂. The morphological investigations (using SEM technique) of pre- and post-sintering powder show elongated (rod like) nanoparticles. The particles are agglomerated and thicker of the presintering sample while clearer and thinner of the post-sintering. The elemental compositions of the pre- and post-sintering powder are confirmed by EDX spectroscopy. The EDX spectrum of the pre-sintering sample shows a weak peak for chlorine as impurity. However, the postsintering material is free of any sort of impurity. The Pb-O and Zr-O bonds are confirmed by IR spectroscopy which gives clear vibrational bands in the range of 600 - 400 cm⁻¹.

Biography

Hameed Ullah is a faculty member in the Department of Chemistry, Faculty of Sciences, Hazara University, Mansehra, Pakistan. He is actively involved in teaching courses with main focus upon the structure, opto-electronic properties, and applications of new materials, especially, the nanomaterials. He is actively involved in research activities, and his main focus is upon the design and development of metal alkoxides which are utilized as molecular single source precursors (SSPs) in MOCVD and sol gel processes for the preparation of metal oxides nano structures.

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