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Hydrothermal Synthesis of Two-dimensional Nanoparticles for Nano Lubricant Applications: A Pathway for Enhanced Efficiency

Dr. S V A R Sastry

Department of Chemical Engineering, HBTU Kanpur, India

Abstract

Two-dimensional (2D) nanomaterials synthesised by hydrothermal means have become a key technology in nanotechnology, especially for applications requiring accuracy in particle shape, crystallinity, and surface properties. This process creates well-defined nanostructures by means of chemical reactions in aqueous medium at high pressures and temperatures. The most extensively researched 2D nanomaterials produced by hydrothermal techniques are iron-based nanoparticles, zinc oxide (ZnO), and titanium dioxide (TiO₂). Advanced lubricants with better tribological properties have been developed through a revolution in the field of lubricants with the addition of nanomaterials. For the purpose of attaining homogeneous dispersion within lubricating matrix, these nanomaterials' size, shape, and surface functionality can be precisely controlled during their hydrothermal production. These two-dimensional nanomaterials can have their surface properties precisely altered through hydrothermal synthesis, which benefits their lubricating system performance. Improved dispersion stability and efficacy of the nanomaterials in the lubricant can result in decreased wear, decreased friction, and enhanced thermal stability. This can be achieved by optimizing the particle size, shape, and surface fictionalization.

Keywords: Hydrothermal Synthesis, Nano Lubricants, Tribology, Two Dimensional Nanoparticles