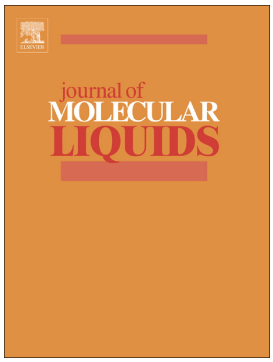

Stable gallium oxide@ silica/polyvinyl pyrrolidone hybrid nanofluids: Preparation, characterization, and photo-activity toward removal of malachite green dye

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Stable gallium oxide@ silica/polyvinyl pyrrolidone hybrid nanofluids: preparation, characterization, and photo-activity towards removal of Malachite green dye

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Abstract

The aim of this research is to investigate the stability of ß-Ga_2O_3 fluids by utilizing the polyvinyl pyrrolidone polymer (PVP) and silica/polyvinyl pyrrolidone nanofluids (SNF) as stabilizers. Nanofluids with 0.025, 0.05, and 0.1 wt% ß-Ga_2O_3 loadings nanoparticles were prepared using a two-step method. Ultrasonic processing was applied to allow the homogeneity and to increase the stability of the prepared samples. Several characterization techniques were adopted to visualize the stability and turbidity rate of the prepared nanofluids viz., UV–vis spectrometry, particle size distribution, Zeta potential, and transmission electron microscopy (TEM). The results revealed that nanofluids ß-Ga_2O_3/SNF are the most stable suspension within 5 days. In addition, the photo-catalytic activity of nanofluids was examined using Malecite green dye (MG) as the hazardous compound. It was found that the ß-Ga_2O_3/SNF nanofluids exhibited higher catalytic efficiency for this reaction. The apparent 1st order for photo-degradation of MG dye was 0.0176 min^{-1} using 0.025 ß-Ga_2O_3/SNF nanofluids.

Keywords: ß-Ga_2O_3 nanoparticles, silica nanofluids, PVP**,** Malecite green dye, photo-degradation.

Introduction

Recently; intensive studies have been done on applications of semiconductor nanostructures due to their potential application [1]. Gallium oxide (Ga_2O_3) has five crystalline structures (α, β, γ, δ, and ε phase Ga_2O_3) [2-5] and it is expected that the photo-catalytic activities of these Ga_2O_3 phases differ from each other. ß-Ga_2O_3; monoclinic form having a wide band gap (Eg) of 4.9 ev; possess unusual physical and chemical properties that are useful in optoelectronic devices, gas sensors, heterogeneous catalysis, solar cells, blue light emitter and luminescent phosphors [3, 6].

Nanofluids are colloidal suspension of nanoparticles in a polymer matrix. It has been of great interest due to their broad applications in different fields [7]. The dispersion of dry particles in liquids has been the most frequently used method to produce nanofluids [8, 9]. It has been demonstrated that the ultrasonic probe is the most effective dispersion system due to its high energy density that breaks the agglomerates more efficiently than the other mechanisms [10, 11]. Only a few