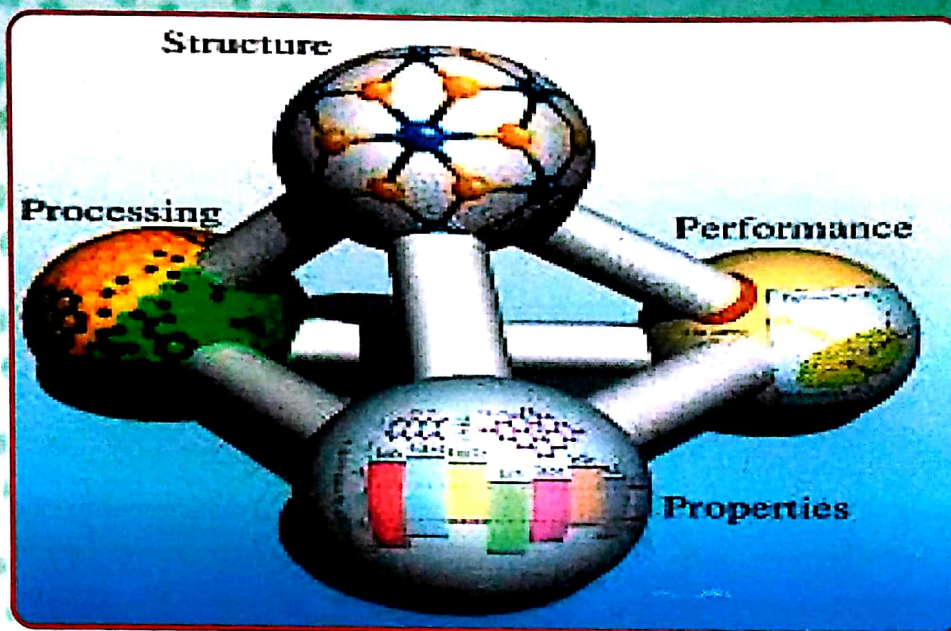


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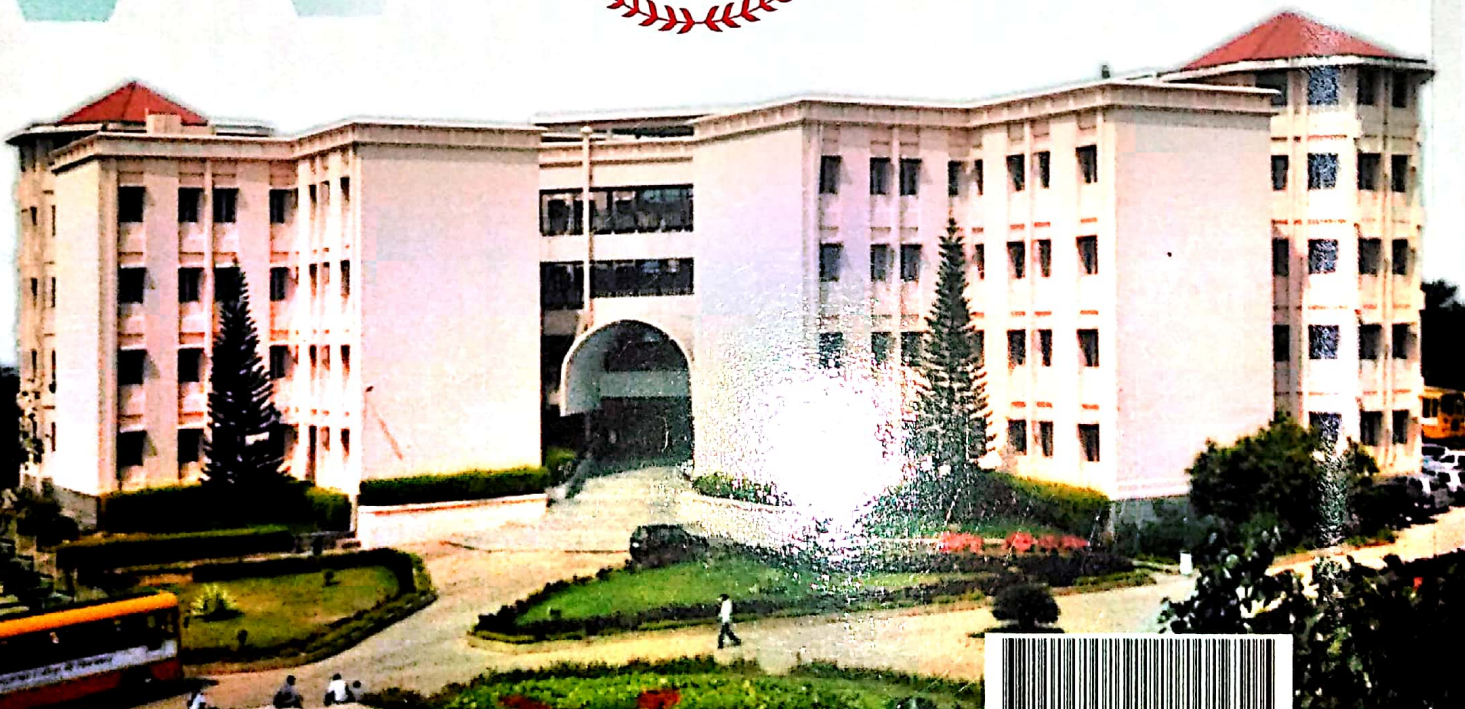
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Optical Thermo Physical and Ultrasonic Properties of Bio-Synthesised Nano (Indium Oxide) Fluids

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Abstract. Green Synthesis and Two-step method have been applied for preparing Indium oxide nanoparticles and nanofluids respectively with base fluid as Ethylene Glycol. The Indium oxide nanoparticles were obtained from Indium (III) Acetylacetonate and katira gum as precursors. The effect of surfactant PVP (2-5% volume) and Gelatin protein (1% by volume) on Indium oxide nanofluids (1% by volume) is observed. The Indium oxide nanofluids were characterized by SEM and EDAX Spectroscopy. The chemical composition and morphology were done by EDAX and SEM respectively. The effect of PVP and Gelatin protein on thermophysical properties (*Thermal Conductivity, Viscosity, Density and Ultrasonic Velocity, Adiabatic Compressibility and Surface Tension*) of Indium oxide nanofluids were observed in the temperature range 30°C to 60°C confirming the Newtonian behaviour of nanofluids.

Keywords: Green synthesis, Indium oxide nano fluid, thermophysical properties, two-step method, , SEM and EDAX, katira gum mediated, PVP, Gelatin.

1. INTRODUCTION

Nanofluid is a term proposed by Choi in 1995 of the Argonne National laboratory U.S.A. In recent years, nanofluids have attracted more and more attention [1,2]. Research in nanofluids has many potential applications [3-5]. Most of the reviews were concerned with the experimental and theoretical studies of the Thermophysical properties of nanofluids [6]. The Two-step method is extensively used in the synthesis of oxide based nanofluids. Several authors have argued that thermal conductivity enhancement is due to hydrodynamic effect of nanoparticles Brownian motion. In₂O₃ nanofluids are very stable due to the protective role of PVP, as it retards the growth and agglomeration of nanoparticles by steric effect. PVP is an efficient agent to improve the stability of suspension [7]. Proteins are polypeptides with a defined conformation whose adsorption change to nanoparticle surface changes with changes in pH. Adsorption of proteins to nanosurface is influenced by solvation forces, hydrogen bonds Van der Waals

interactions, etc. PVP and Gelatin protein act as efficient agents to improve the stability of suspension [8]. Proteins in vivo are very complex biological systems. Inside the cell the nanoprotein complexes may be processed by different cellular pathways. Temperature induced structural changes can result in different responses in vitro. Thermal vibrations cause polymer to lose its structure allowing greater surface area to nanoparticles to take part in heat transfer. Nanoparticle surface may get pre-coated with specific proteins inside a cellular environment.

2. EXPERIMENTAL

2.1 Fabrication of In₂O₃ nanoparticles and In₂O₃ nanofluid with Gelatin protein

The stable In₂O₃ nanofluid is obtained by using In₂O₃ nanoparticles synthesized from Indium (III) Acetylacetonate and katira gum, base fluid (EG), surfactant (PVP) and Gelatin protein as shown in the

3. RESULTS AND DISCUSSION

3.1 EDAX and SEM Analysis

In Figure 2, the EDAX spectrum of the In_2O_3 and nano fluids (sample 1 and sample 2) containing 'In' and 'O' as main constituent components indicate no contamination is present due to PVP and Gelatin proteins and their atomic and weight ratios confirm the literature values. The SEM images of In_2O_3 nano fluids of (samples 1 and 2) show the random distribution of nanoparticles having spherical shape of large surface area with porous nature is observed.

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FIGURE 4. This is the style for Figure Captions. Center this if it doesn't run for more than one line. Number the figure sequentially as they appear in the manuscript

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$$\frac{d[F_1]}{d\omega_2} = SAm_2 \cos \omega. \quad (1)$$

flowchart (Figure 1) and the different compositions for synthesis are shown in Table below

In_2O_3 : PVP : Gelatin weight ratio	Description
1 : 2 : 1 (Sample-1)	0.2 g of In_2O_3 with 0.4 g of PVP and 0.2 g of Gelatin in 200 ml EG
1 : 5 : 1 (Sample-2)	0.2 g of In_2O_3 with 1 g of PVP and 0.2 g of Gelatin in 200 ml EG

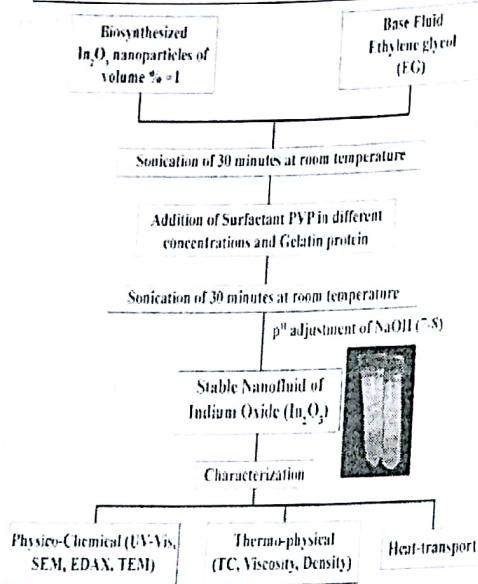


FIGURE 3. Flowchart for the synthesis of In_2O_3 nano fluids using gelatin protein

4. CONCLUSIONS

Conclusions must be brief and should give the entire findings of our research on this topic. Conclusions should not be the same as that of abstract. This is the standard font and layout for the individual paragraphs. Replace this text with your text.

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