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Stability and Zeta Potential measurement of Nanofluids of Ag Nanoparticles

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ABSTRACT

The silver nanoparticle was synthesized via thermal decomposition method at 700°C. Reducing agent NH_2CONH_2 is added to the mixture of $AgNO_3$ in order to form the silver nanoparticle. In the present work we have prepared the silver nanoparticle in powder form from silver nitrate of AR grade by thermal decomposition method. As silver is monovalent therefore 3gm $AgNO_3$ is taken in crucible then it is grinding and mixed at atomic level with 0.8834 gm of urea used as a fuel. Then combustion was taking place in furnace at 700°C. Then sample was again grinding in crucible. Attempt has been made to characterize the nanoparticle by XRD. Nanofluids of Ag Nanoparticles were prepared by two step method in methanol base fluid and study its stability by measuring thermal conductivity and Zeta potential and predicts the surface of nanoparticle and nanoparticle surfactant interactions [1-4].

Keywords : Ag Nanoparticle, XRD, Thermal Conductivity, Zeta Potential.

I. INTRODUCTION

Nanofluids are solid-liquid composite materials consisting of solid nanoparticles with size typically of 1-100 nm suspended in liquid. Nanofluids have attracted great interest recently because of reports of greatly enhanced thermal properties. Surface area of the nanomaterial is increased with reduced in their size. At the nanoscale dimensions, the material properties change significantly from their bulk matter. When matter is reduced in size, it changes its characteristics, caused by the change of mechanical, electronic, physical, chemical, optical, magnetic and biological properties. The stability of nanofluids provides useful information regarding the interaction at the atomic level in the suspension.

II. Synthesis of Ag Nanoparticles

The silver nanoparticle was synthesized by thermal decomposition method at 700°C. Reducing agent NH_2CONH_2 is added to the mixture of $AgNO_3$ in order to form the silver nanoparticle. XRD pattern of silver nanoparticle is taken and it is compared with standard JCPDS data of silver, it is hold good. All the chemical reagent are AR grade. Most metal nitrates thermally decompose to the respective oxides, but silver oxide decomposes at a lower temperature than silver nitrate, so the decomposition of silver nitrate yields elemental silver instead. The structure of prepared silver nanoparticle has been investigated by X-ray diffraction (XRD) analysis. Typical XRD pattern of sample, prepared by the present chemical method are shown in the Figure1. The XRD study indicates the formation of silver nanoparticles.

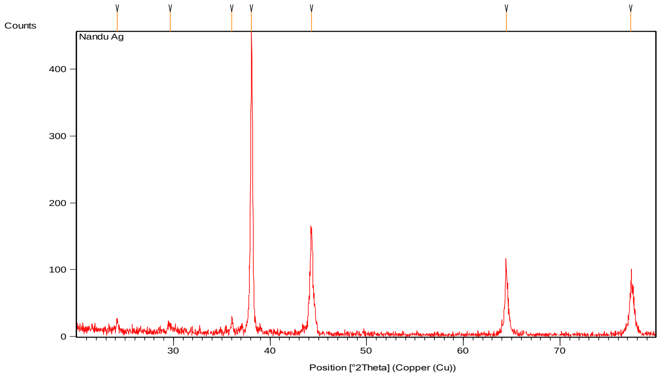

Figure 1. XRD pattern of Ag nanoparticles.

From this study, average particle size has been estimated by using Debye-Scherrer formula

$$D = \frac{0.9\lambda}{WCos\theta} \qquad ....(1)$$

Where 'λ' is the wavelength of X-ray (0.1541nm), 'W' is FWHM (full width at half maximum), 'θ' is the diffraction angle and 'D' is particle diameter (size). The average particle size is calculated to be around 30 nm.

III. Zeta Potential measurements

Zeta potential of the prepared Ag nanofluids was measured by using Zeta potential analyser. It is the potential difference across phase boundaries between solids and liquids. It is observed that zeta potential for molar concentration 0.4 have higher values indicating more stability of Ag nanofluids indicating in figure 2. Moreever it has less values for other molar concentration indicating less stability. From the graph the values of zeta potential has been greater than 30 either positive or negative exhibit the more stability of the nanofluids.

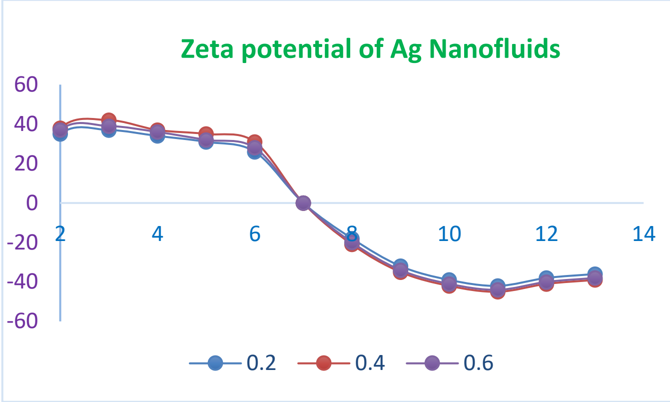

Figure 2. Zeta potential of Ag nanofluids in methanol

IV. Thermal conductivity

Figure 3 shows the variation of thermal conductivity with molar concentration of Ag Nanoparticles of nanofluids in methanol. The results clearly show that the effective thermal conductivity of nanofluid increases with temperature. It has substantially higher value for molar concentration 0.6 indicating more stability of nanofluids because of high specific surface area and therefore more heat transfer surface between nanoparticles and fluids. The thermal conductivity enhancements are highly dependent on specific surface area of nanoparticle, with an optimal surface area for the highest thermal conductivity. The strong relationship between Brownian motion and temperature of nanoparticles are also responsible for increase in thermal conductivity [24-34].

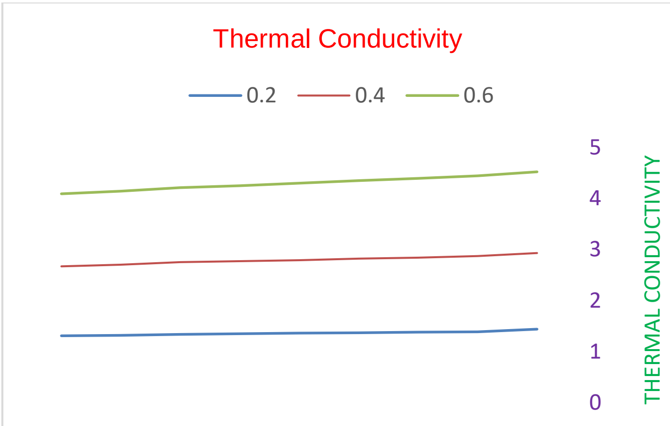

Figure 3. shows the variation of thermal conductivity with molar concentration at 20^{0}C, 25^{0}C & 30^{0}C

V. CONCLUSION

1. The observed higher values of zeta potential indicate the stability of nanofluids.
2. Besides thermal conductivity effect, future research should consider other properties, especially viscosity and wettability, and examine systematically their influence on flow and heat transfer. An in depth understanding of the interactions between particles, stabilizers, the suspending liquid and the heating surface will be important for applications.
3. Enhancement in thermal conductivity of Ag nanofluids is due to the stability of Ag nanoparticles in dispersion medium.

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