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Dielectric study of polar binary fluid (Ethyl acetate + Diethylamine) and non polar hybrid CuO nanofluid (CuO + Diethylamine + Benzene)

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Abstract: *Polar binary fluids and hybrid CuO nano fluids were prepared with the aid of ultrasonicator. Dielectric studies of polar binary fluids (Ethyl acetate + Diethylamine) and hybrid Cuo nano fluids (CuO + Diethylamine + Benzene)were carried out for various concentratios ranging from 0.01M to 0.06M at different temperature ranges from 278K to 318K. Based on the dielectric data, the molecular interactions between the solute- solvent were analyzed. Results revealed that the addition CuO nanoparticle enhances the heat transfer ability of the binary fluid.*

Key words: *Polar binary fluids, non polar hybrid CuO nano fluid, dielectric constant, molecular interaction.*

1.Introduction

Now a days, the dielectric constants of organic liquids and nanofluids have considerable interest in the molecular interaction study of the solutions as well as in heat transfer applications. The dielectric behavior of polar and non-polar solutions has been studied by the many researchers [1-4]. In the present work, we have studied the dielectric constant of polar binary fluids and non-polar hybrid Cuo nano fluids. Dielectric behaviors of these liquids were studied with respect to the frequency. The fluids taken for the study has a special bonding structure of N-H and =O. The dielectric constant of polar binary fluids and hybrid CuO nano fluids gives the information of molecular interaction of the compound fluids.

2. Experimental details

The Chemicals DEA, Ethyl acetate and Benzene were purchased from Merck Ltd. These chemicals were 99% pure and used for the study without further purification. The solutions were prepared at various concentrations ranges from 0.01M to 0.06M. In order to get uniform mixing, the liquid was kept in ultrasonic bath for 10 minutes. There are two method of preparation of nano fluids,in this we followed two step method [5,6.] The techniques like high shear [7]and ultrasound[8] are generally used to disperse the prepared nano particle in to the base fluid.

In the hybrid CuO nanofluid preparation, the commercially purchased CuO nano powder were used for the study. Nano powder weighing from 0.01gm to 0.06gm was added to the prepared binary fluid. The mixture was sonicated for 45 minutes using probe ultra sonicator to get uniform suspension. The stability of the solution was maintained throughout the study without adding any surfactants. The dielectric studies were carried out for the binary polar fluids and hybrid CuO nano fluids at different temperature ranges from 298K to 318K. The dielectric constants of these solutions are measured using the dielectric cell.

3. Result and discussion

Dielectric constants of polar, non-polar binary fluids such as (DEA+ Ethyl acetate),(DEA+ Benzene) and hybrid CuO nano fluid (CuO+DEA+benzene) were measured at different concentration ranges from 0.01M to 0.06M.

In the system DEA + Ethyl acetate, the dielectric constant values are high. Also, the dielectric constant values increases as concentration increases and it decreases with the increase of temperature shown in fig.1. The increase in dielectric constant of acetate based binary fluid (9) may be due to the interaction of =O in the acetate group with the N-H group in DEA.

Benzene has the very low dielectric constant. When DEA is added the dielectric constant value increases with the increase of concentration but decreases with the increase of temperature as displayed in fig.2. The increment in the dielectric constant is due to the addition of DEA, because DEA may participate in a weak hydrogen bonding. N-H group serves as a source of protons (H^+). In general non-polar molecules have zero dipole moment; the induced dipole interaction is possible in such type of solvents. A very small amount of addition of DEA does not bring the appreciable change in the value of ε in the binary fluid and also it produces weak interaction between the molecules. This weak bonding gets altered when increasing the temperature.

The dielectric behaviour of the non-polar hybrid nanofluid CuO + DEA + benzene, is diplayed in fig.3. It is evident that the addition of CuO nanoparticle in the DEA + Benzene binary fluids, alter the dielectric behaviour of the binary fluids. This is due to the interaction of particle and the fluids. Also, particle- fluid interaction is dominant than the interaction between the binary fluid molecules.

4. Conclusion

In this present work, dielectric measurements of polar , non-polar binary fluids and hybrid CuO nanofluid were measured at different concentrations and temperatures. The weak interactions present in the binary fluid and hybrid nanofluid were confirmed. Also, it is confirmed that structural changes occurr in the fluids, while increasing the temperature and hence the dielectric constant values decreases uniformly with the increase of temperature for all the systems studied. The dominance of particle – fluid interaction is noticed. The addition of CuO nanoparticle in the DEA+ Benzene binary fluids reveals the influence of nanoparticle in the dielectric behoaviour of basefluids.

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Figure captions

Figure 1. Variation of dielectric constant with the concentration of DEA in Ethyl acetate at various temperatures (298K to 318K).

Figure 2. Variation of dielectric constant with the concentration of DEA in Benzene at various temperatures (298K to 318K).

Figure 3. Variation of dielectric constant with the concentration of CuO dispersed in DEA + Benzene at various temperatures (298K to 318K) .

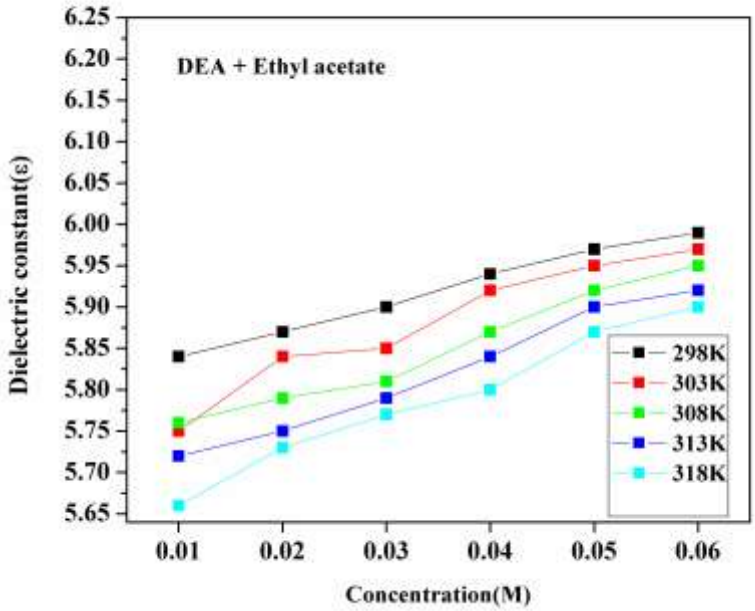

Figure 1. Rohini et al.

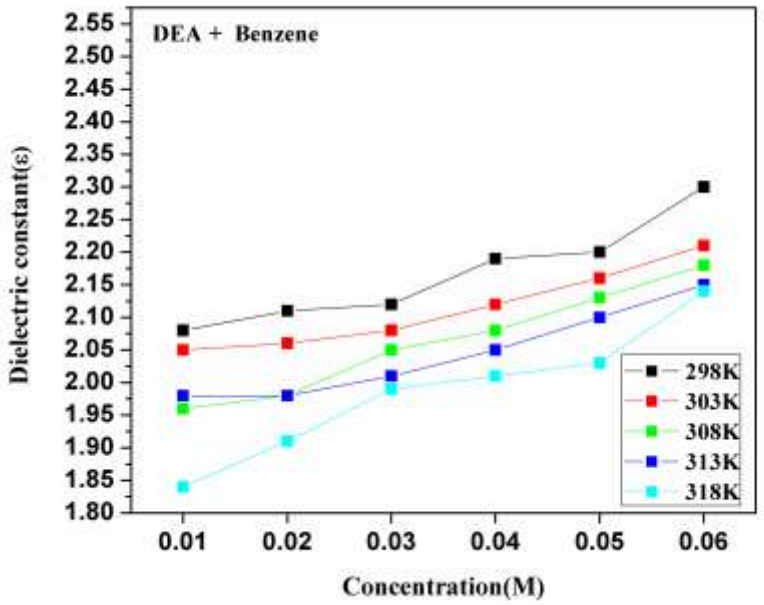

Figure 2. Rohini et al.

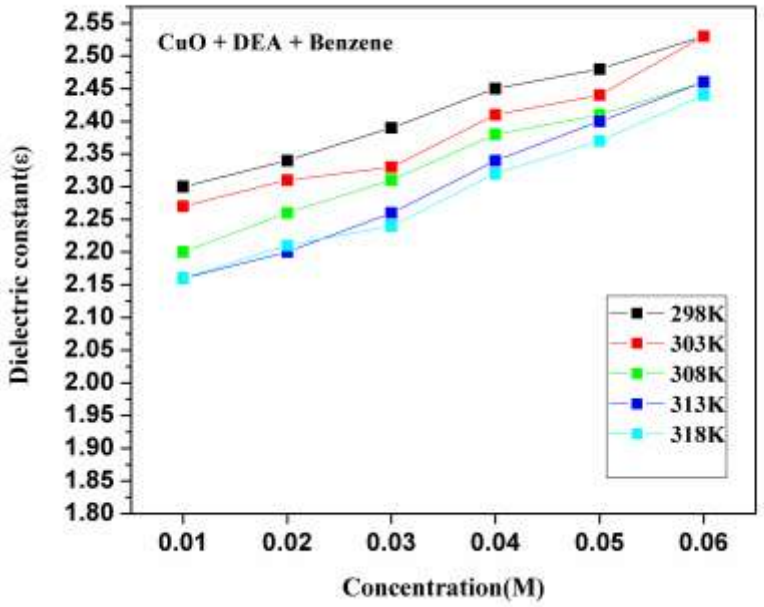

Figure 3. Rohini et al.

