Influence of size and concentration on the physical properties of Glycerol/Cu$_2$O nanofluid

R. Heyd, M.L. Saboungi  
CRMD - UMR6619 CNRS, Orléans University, Orléans 45000, France  

A. Hadaoui, M. Fliyou, A. Koumina  
ENS, Cadi Ayyad University, Marrakech 40000, Morocco  

E.L. Ameziane, A. Outzourhit  
LPSCM, Cadi Ayyad University, Marrakech 40000, Morocco  

The first syntheses of nano-sized particles appeared in the late 1990s. Compared to the bulk, the small size of these newly synthesized nanoparticles allows us to expect a dramatic increase in their physical properties.  

In the field of heat transfer, the low thermal conductivity of most fluids (water, oils, ...) is an obstacle to a good transfer of thermal energy in many industrial applications. In general, the introduction of small amounts of metal nanoparticles significantly improves the thermal conductivity of these liquids. If this significant improvement can often be described by phenomenological laws like rules of mixing, a better understanding of heat transfer at the nanoscale is required for prediction of the properties of these nanofluids.  

In this work we studied the influence of Cu$_2$O nanoparticles size and concentration on rheological and thermal properties of glycerol, a biocompatible fluid. Investigations of the influence of nanoparticles suspension on biocompatible fluids viscosities is of great interest in view of applications ranging for example from injection in the human blood of nanoparticles as therapeutic vector for the treatment of cancerous tumors to the use as coolant in thermal transfer applications. The study of rheological properties of nanofluids is an area that still attracts a lot of interest, both theoretically and experimentally, since the effects obtained by the use of nanoparticles in stable suspensions remain largely unexplored and unexplained.  

Cu$_2$O nanoparticles have been synthesized, characterized and stabilized in glycerol at the “Center for Research on Divided Matter” of Orleans (CRMD - UMR 6619) in France. The thermal characterization of these nanofluids has been performed with an adapted $3\omega$ method at the “Laboratory of Physics of Nanostructures” (LPN - ENS) and at the “Laboratory of Physics of Solids and Thin Films” (LPSCM - Semlalia Faculty of Science) of Marrakech, Cadi Ayyad University. The rheological characterization of samples based on the temperature, on Cu$_2$O nanoparticles size and concentration, was carried out at the CRMD with a Kinexus rotational rheometer from Malvern.