Modeling the Thermal Conductivity of Nanofluids Via the Use of Density Scaling

Lilia Alejandra Hernández-Zarazúa [S], Martha Leticia Hernández-Pichardo and Ricardo Macías-Salinas [C]
SEPI-Departamento de Ingeniería Química, Instituto Politécnico Nacional, México, D.F., México
rms@ipn.mx

Casalini and Roland [*Phys. Rev.* E **69**, 062501 (2004); *J. Non-Cryst. Solids***353**, 3936 (2007)] have effectively proved that both the dielectric relaxation times and the viscosity of liquids can be graphically represented into a single master curve as a function of the thermodynamic potential ($T\,\rho^{-\gamma}$), where T is the temperature, ρ is the molar density, and $\gamma$is a state-independent scaling exponent. In this work, we applied the aformentioned thermodynamic scaling to the thermal conductivity of novel thermal fluids: namely, nanofluids. The term nanofluid refers to suspensions of nanometric solid particles (CuO, Al_2O_3, etc) in any base fluid (water, ethylene glycol, etc.). Unlike previous studies on density scaling of transport properties, a more suitable normalization of the thermal conductivity of the nanofluid was used in this work in order to obtain improved correlations of thermal conductivity over much wider ranges of temperature and volumetric fraction of the nanoparticle. A calculation procedure is also described here to optimize the value of the scaling exponent γ that ensures the best superpositioning of all experimental isotherms considered.