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Isopropyl Palmitate Based Nanofluids Containing Spherical Mgo Nanoparticles for Electronics Cooling

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Extended Abstract

Increased demand for the processing capabilities of electronic devices leads devices to perform complex tasks, which requires higher performance of the components. In addition, there is a trend moving towards miniaturisation and lightweight. This situation involves higher heat flux density to be removed in the electronic devices, evidencing those usual technologies such as natural or forced air cooling are insufficient. Liquid cooling can solve as such heat dissipation problems, allowing higher heat transfer rates. The use of nanofluids, suspensions of solid nanometric materials within a base fluid, allows enhancing the heat transfer process in such cooling systems due to the improved thermophysical properties compared to conventional heat transfer fluids.

In this work, new nanofluids based on dispersions of MgO nanoparticles in isopropyl palmitate (IPP) at different concentrations have been developed. Temporal stability and thermophysical properties (density, thermal conductivity, isobaric heat capacity) were studied using different experimental techniques. The stability was analysed by observing the evolution of the hydrodynamic size of nanoparticles dispersed in the base fluid (IPP) for 24 days. All samples showed good temporal stability, the average hydrodynamic size of the samples remained constant at about 244 nm. Density of designed nanofluids and base fluid were determined using the oscillating U-tube technique in the temperature range from 293.15 to 313.15 K. The evolution of density over temperature is similar for base fluid and the designed nanofluids, decreasing with temperature up to 1.7%. Thermal conductivity was measured in the temperature range from 293.15 to 333.15 K using a transient hot-wire method. The thermal conductivity slightly decreases with temperature in the studied temperature range, nanofluids following the same trend as base fluid. Moreover, the higher the nanoparticle content, the higher the thermal conductivity, with an increase in conductivity of around 5% at a nanoparticle mass fraction of 2.0 wt%. The isobaric heat capacities values of nanofluids and base fluid were determined within the solid (243.15 to 263.15 K) and liquid phases (283.15 to 313.15 K), using a quasi-isothermal temperature modulated differential scanning calorimeter method. The heat capacity–temperature dependence of designed nanofluids is similar to that of the base fluid: increasing isobaric heat capacities values over the temperature range analysed. Moreover, the isobaric heat capacity decreases up to 6% as the amount of dispersed nanoparticles in the base fluid increased, for the studied concentrations. The results obtained in this study show that IPP-based MgO nanofluids are very promising alternative fluids for liquid cooling of electronic devices.

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