Parametric Analysis of the Heat transfer behavior of the Nano-particle ionic-Liquid Flow between Concentric Cylinders

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Abstract

The paper urges to investigate the enhanced viscous behavior and the heat transfer phenomenon of the unsteady ionic-nano-liquid squeezing flow between the two infinite parallel concentric cylinders. The physical scenario is transformed into a partial differential equation system by the modified Navier stokes equation, the Poisson equation, the Nernst-Plank equations, and the energy equation. The PDE’s system is transformed into the coupled ODE’s system by opting for suitable/applicable transformation. The solution of the coupled differential equations system is carried out by the Parametric continuation method (PCM) and BVP4c Matlab based methods. The effect of the squeeze number, the nanoparticle volume fraction, the Prandtl number, Schmidt number, and the heat source parameter on nano-ionic liquid flow, heat transfer rate, and other physical variables are tabulated, graphed, and discussed. The analysis of the Nusselt number for Cu-water, Al2O3-water, and TiO2-water in response to the Prandtl number(Pr), the Squeeze number(S), and the heat source parameter(Hs) concludes that the Cu-nanoparticle is the best choice for the heat transfer function through the contracting flow channel with the increasing heat transfer parameter(Hs). It is also noticed that the thermal boundary layer tends to decrease for the increasing Prandtl number(Pr) in Cu-water, Al2O3-water, and TiO2-water, which indicates that the convection mode of heat transfer is not efficient in this whole flow set-up. Applications of this study involved in the demands to understand the interfacial electrokinetic phenomena in the liquid transport processes which increase significantly as various Micro-Electro-Mechanical Systems (MEMS) and MicroFluidic devices involve liquid transport processes.

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