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Forced convective transport of alumina-water nanofluid in micro-channels subject to constant heat flux

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Abstract

A modified Buongiorno model of nanofluids was established with full considerations of scaling effects and four driving mechanisms of nanoparticles migration in micro-channels. In order to reveal nanoparticles migration, heat transfer and pressure drop characteristics of alumina-water nanofluid in hydrodynamically and thermally fully developed region of micro-channels, the proposed governing equations were solved by means of the Runge-Kutta-Gill method. The obtained results demonstrated that the viscous dissipation term exhibits adverse influence on heat transfer performance for heating and cooling cases. Moreover, it has been found that the increase of the amount of slip velocity and temperature jump at the wall not only enhances heat transfer, but also decreases pressure drop, indicating promising application prospects of nanofluids in micro-channels. Eventually, four driving mechanisms of nanoparticles migration are discussed. The results clearly indicated that Brownian diffusion and thermophoresis are more important than shear-induced diffusion and viscosity gradient-induced diffusion.

Keywords: Alumina-water nanofluid; Nanoparticles migration; Scaling effects;