Effects of Brownian Motion of Nanoparticles on Heat Transfer and Entropy Generation of Al_2O_3-Water Nanofluid Mixed Convection

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Abstract:

The aim of this numerical study is to investigate effects of considering Brownian motion of nanoparticles on mixed convection and entropy generation of Al2O3-water nanofluid within a lid-driven square cavity. Horizontal walls of the cavity are thermally insulated, while the left and right vertical walls are kept at different constant temperatures of Th and Tc, respectively. Moreover, the top wall of the enclosure moves from the left to right with a constant speed of Up. To take into account or neglect the Brownian motion two different combinations of models for the viscosity and conductivity of the nanofluid are considered. After verifying the numerical procedures, simulations are performed for Ri numbers of 0.01, 0.1, 1, 10 and 100 and nanoparticle volume fractions ranging between 0 and 0.05. The results show significant differences between the average Nusselt number and total entropy generation when Brownian motion is considered compared with the case when it is neglected. For all of the Ri numbers studied, higher Nusselt numbers are noticed compared to the cases when it is neglected. Also, except for low Ri numbers and high volume fractions of nanoparticles, the total entropy generation is less when Brownian motion is considered.