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Conjugate natural convection flow of Ag–MgO/water hybrid nanofluid in a square cavity
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Abstract
The conjugate natural convection of a new type of hybrid nanofluid (Ag–MgO/water hybrid nanofluid) inside a square cavity is addressed. A thick layer of conductive solid is considered over the hot wall. The governing partial differential equations (PDEs) representing the physical model of the natural convection of the hybrid nanofluid along with the boundary conditions are reported. The thermophysical properties of the nanofluid are directly calculated using experimental data. The governing PDEs are transformed into a dimensionless form and solved by the finite element method. The effect of the variation of key parameters, such as the volume fraction of nanoparticles, Rayleigh number, and the ratio between the thermal conductivity of the wall and the thermal conductivity of the hybrid nanofluid (Rk), is studied. Furthermore, the effects of the key parameters are investigated on the temperature distribution, local Nusselt number, and average Nusselt number. The results of this study show that the heat transfer rate increases by adding hybrid nanoparticles for a conduction-dominant regime (low Rayleigh number). The heat transfer rate is an increasing function of both the Rayleigh number and the thermal conductivity ratio (Rk). In the case of a convective-dominant flow (high Rayleigh number flow) and an excellent thermally conductive wall, the local Nusselt number at the surface of the conjugate wall decreases substantially by moving from the bottom of the cavity toward the top. © 2019, Akadémiai Kiadó, Budapest, Hungary.

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