International Communications in Heat and Mass Transfer
Volume 126, July 2021, 105428

Numerical study of mixed convection of nanofluid inside an inlet/outlet inclined cavity under the effect of Brownian motion using Lattice Boltzmann Method (LBM)

Xinying Zhang [a], Ying Xu [a], Jian Zhang [a], Amin Rahmani [b], S. Mohammad Sajadi [c d], Majid Zarringhalam [e], Davood Toghraie [f]

https://doi.org/10.1016/j.icheatmasstransfer.2021.105428

Abstract

In the present numerical study, the mixed convection of Cu-water and CuO-water nanofluids is modeled inside an inclined square-shaped cavity by utilizing the thermal model of the Lattice Boltzmann Method (LBM). A cold fluid flow enters into the cavity at the upper side of the left wall and, after being heated by the hot obstacle, exits from the lowest right side of the cavity The effective thermal conductivity and viscosity of nanofluids are computed by the KKL (Koo-Kleinstreuer-Li) equation. The results are presented in the constant Rayleigh number of 104 and the Richardson numbers of 0.1,1 and 10. Obtained results reveal that by incrementing Ri because of the augmentation of inlet fluid velocity from the left side, the gradient of isothermal lines decreases, and temperature distribution becomes more uniform, leading to Nusselt number reduction on hot wall. Although the Nu_{avg} enhances considerably in Ri of 0.1, in Ri=1 and 10, there is no sensible change. In the angle of 0o, by augmenting Ri, Nu_{avg} decreases, but in the angle of 60o, by increasing Ri from 0.1 to 1, Nu_{avg} increments up to 22%. This augmentation is due to the change of angle of the collision of flow with the hot obstacle. Furthermore, when the hot obstacle is located in the flow path, heat transfer improves. Application of such studies shows its importance in the design of electronic components cooling systems, solar energy storage, heat exchangers, and lubrication systems.