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Entropy generation analysis of magneto-nanoliquids embedded with aluminium and titanium alloy nanoparticles in microchannel with partial slips and convective conditions

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Abstract
Purpose: Outstanding features such as superior electrical conductivity and thermal conductivity of alloy nanoparticles with working fluids make them ideal materials to be used as coolants in microelectromechanical systems (MEMSs). This paper aims to investigate the effects of different alloy nanoparticles such as AA7075 and Ti6Al4V on microchannel flow of magneto-nanoliquids with partial slip and convective boundary conditions. Flow features are explored with the effects of magnetism and nanoparticle shape. Heat transport of fluid includes radiative heat, internal heat source/sink, viscous and Joule heating phenomena.
Design/methodology/approach: Suitable dimensionless variables are used to reduce dimensional governing equations into dimensionless ordinary differential equations. The relevant dimensionless ordinary differential systems are computed numerically by using Runge–Kutta–Fehlberg-based shooting approach. Pertinent results of velocity, temperature, entropy number and Bejan number for assorted values of physical parameters are comprehensively discussed. Also, a closed-form solution is obtained for momentum equation for a particular case. Analytical results agree perfectly with numerical results. Findings: It is established that the entropy production can be improved with radiative heat, Joule heating, convective heating and viscous dissipation aspects. The entropy production is higher in the case of Ti6Al4V-H2O nanofluid than AA7075-H2O. Further, the inequality Ns(ξ)Sphere > Ns(ξ)Hexahedran > Ns(ξ)Tetrahydran > Ns(ξ)Column > Ns(ξ)Lamina holds true. Originality/value: Effects of aluminium and titanium alloy nanoparticles in microchannel flows by using viscous dissipation and Joule heating are investigated for the first time. Flow features are explored with the effects of magnetism and nanoparticle shape. The results for different alloy nanoparticles such as AA7075 and Ti6Al4V have been compared. © 2019, Emerald Publishing Limited.

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