Stagnation-point flow and heat transfer over a stretching/ shrinking cylinder in nanofluids

ABSTRACT

A mathematical model is analyzed to study the effects of stretching/shrinking cylinder on a steady stagnation point flow and heat transfer characteristics in nanofluid. Using similarity transformation, the governing partial differential equations in cylindrical form are transformed to ordinary differential equations. The resulting system of equation are solved numerically for three nanoparticles, namely copper (Cu), alumina (Al_2O_3) and titania (TiO_2) in a water-based fluid with Prandtl number Pr = 6.2 by using a shooting method. The effects of the curvature parameter γ , stretching/shrinking parameter λ , solid volume fraction φ and heat transfer characteristics are thoroughly examined. It is found that dual solutions are exist for shrinking cylinder. It is observed that the surface shear stress and the heat transfer rate are increase as γ increases. This study also considered when the value of γ is very large and shows that the cylinder increases the range of existence of the similarity solution compared to flat plate (γ= 0) . The results also shows that the skin friction coefficient and heat transfer rate increase as the value of φ is increase and Cu-water is the best heat transfer nanofluid compared to Al_2O_3-water and TiO_2-water.

Keyword: Boundary layer; Stagnation point; Stretching and shrinking cylinder; Dual solutions; Nanofluid