Slip effect on mixed convection flow past a thin needle in nanofluid using Buongiorno's model

ABSTRACT

This work examines the effect of the buoyancy force or mixed convection on the steady two dimensional nanofluid flow over a vertical thin needle with the presence of velocity slip on the surface. The nanofluid model used for the present study incorporates the influence of the Brownian motion and thermophoresis. The governing equations in the form of partial differential equations are transformed into nonlinear ordinary differential equations, before being solved numerically using bvp4c package in MATLAB software. Special priority has been given to the physicalparameters of interest, including mixed convection, velocity ratio, Brownian motion, thermophoresis, slip and needle thickness. The impacts of those parameters are described in detail through graphs for the velocity, temperature and concentration profiles, skin friction coefficient, local Nusselt number and also local Sherwood number. The outcome of the study shows that the existence of the dual solutions is noticed when the needle and the buoyancy force against the direction of the fluid motion. It is reveals from the study that the presence of the velocity slip increases the magnitude of the skin friction coefficient, heat and mass transfer in the system.

Keyword: Dual solutions; Mixed convection; Nanofluid; Thin needle; Velocity slip