Mixed convective stagnation point flow of a thermally stratified hybrid Cu-Al2O3/water nanofluid over a permeable stretching/shrinking sheet

ABSTRACT

The study scrutinizes the coupled effects of thermal stratification and mixed convection on boundary layer flow and heat transfer of a hybrid Cu-Al2O3/water nanofluid. Stretching/shrinking surface is permeable to allow the wall fluid suction while thermal convection is also included to deal with the thermal stratification phenomenon. In the present work, the combination of copper (Cu) nanoparticles and Al2O3/water nanofluid is modelled using the analytical hybrid nanofluid model. A similarity transformation is adopted to reduce the governing model into a set of ordinary (similarity) differential equations. The efficient boundary value problem with fourth order accuracy (bvp4c) solver in MATLAB software is utilized to solve the transformed model. An astonishing result is obtained where the heat transfer rate of hybrid nanofluid intensifies when small suction parameter is imposed on the stretching/shrinking sheet while a contrary result is obtained when higher value of suction is applied. Suction and opposing buoyancy parameters are among the control parameters that induce the existence of second solution. Stability analysis affirms that the first solution is mathematically stable. The present results are conclusive to the combination of alumina and copper nanoparticles only and other combination of nanoparticles may produce different flow and heat transfer characteristics.

Keyword: Stagnation point flow; Hybrid nanofluid; Stretching/shrinking; Thermal stratification; Dual solutions