Documents

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A numerical investigation of transient MHD free convective flow of a nanofluid over a moving semi-infinite vertical cylinder

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Abstract

Purpose - The purpose of this paper is to study numerically the influence of a magnetic field on the transient free convective boundary layer flow of a nanofluid over a moving semi-infinite vertical cylinder with heat transfer Design/methodology/approach - The problem is governed by the coupled non-linear partial differential equations with appropriate boundary conditions. The fluid is a water-based nanofluid containing nanoparticles of copper. The Brinkman model for dynamic viscosity and Maxwell-Garnett model for thermal conductivity are used. The governing boundary layer equations are written according to The Tiwari-Das nanofluid model. A robust, well-tested, implicit finite difference method of Crank-Nicolson type, which is unconditionally stable and convergent, is used to find the numerical solutions of the problem. The velocity and temperature profiles are studied for significant physical parameters such as the magnetic parameter, nanoparticles volume fraction and the thermal Grashof number Gr. The local skin-friction coefficient and the Nusselt number are also analysed and presented graphically. Findings - The present computations have shown that an increase in the values of either magnetic parameter M or nanoparticle volume fraction decreases the local skin-friction coefficient, whereas the opposite effect is observed for thermal Grashof number Gr. The local Nusselt number increases with a rise in Gr and f values. But an increase in M reduces the local Nusselt number. Originality/value - This paper is relatively original and presents numerical investigation of transient two-dimensional laminar boundary layer free convective flow of a nanofluid over a moving semi-infinite vertical cylinder in the presence of an applied magnetic field. The present study is of immediate application to all those processes which are highly affected by heat enhancement concept and a magnetic field. Further the present study is relevant to nanofluid materials processing, chemical engineering coating operations exploiting nanomaterials and others. © Emerald Publishing Limited.

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