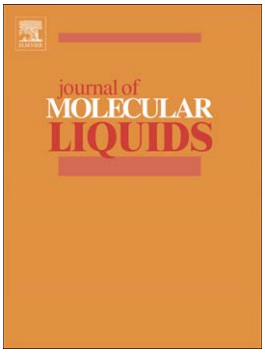

Unsteady Ferromagnetic Liquid Flow and Heat Transfer Analysis over a Stretching Sheet with the Effect of Dipole and Prescribed Heat Flux

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PII: S0167-7322(16)31251-X
DOI: doi: 10.1016/j.molliq.2016.07.145
Reference: MOLLIQ 6166

To appear in: *Journal of Molecular Liquids*

Received date: 19 May 2016
Accepted date: 20 July 2016

Please cite this article as: A. Majeed, A. Zeeshan, R. Ellahi, Unsteady Ferromagnetic Liquid Flow and Heat Transfer Analysis over a Stretching Sheet with the Effect of Dipole and Prescribed Heat Flux, *Journal of Molecular Liquids* (2016), doi: 10.1016/j.molliq.2016.07.145

Unsteady Ferromagnetic Liquid Flow and Heat Transfer Analysis over a Stretching Sheet with the Effect of Dipole and Prescribed Heat Flux

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This paper is mainly focused on unsteady boundary layer flow ferromagnetic fluid and heat transfer past a stretching surface with the influence of magnetic dipole. The momentum and energy equation are expressed as five parameter problem, which is solved numerically by employing shooting based RKF-45 method. Two different types of thermal boundary conditions are studied, namely, (i) prescribed surface temperature (PST) and (ii) prescribed heat flux (PHF). The effects of the various emerging parameters involving in the problem on dimensionless velocity and temperature distributions are illustrated graphically and tabular form. It was establish that the key factor of the magneto-thermomechanical intervention is to slow down the fluid motion in the comparison to the simple hydrodynamic. Comparisons of present results were made with those available in open literature and found excellent agreement.

Keywords: Ferromagnetic fluid, point Dipole effect, prescribed heat flux, prescribed surface temperature, magneto-thermomechanical effects, stretching sheet.

1.INTRODUTION

The boundary layer flow and heat transfer due to a stretching surface has gained extensive interest for the scientist because of their wider range of application in industrial and manufacturing processes such as electro-chemistry, drawing, tinning and annealing of copper wires, polymer sheet extrusion from a dye, metal spinning, and hot rolling, glass fiber and paper production [1-3]. It is difficult to understand the heat and flow characteristics process so that the worth of the final product depends on the heat transfer rate at stretching sheet. The boundary layer behavior over a continuous solid surface with a uniform velocity was first considered by Sakiadis [4] and experimentally confirmed by Tsou et al. [5]. The work of Sakiadis [4], then extended by Crane [5] to obtain a closed form analytical solution for two dimensional boundary layer equations due to a stretching surface in a quiescent incompressible fluid. The heat transfer analysis of water based nanofluid flow over a stretching sheet in the presence of buoyancy and thermal radiation with the effect of transverse magnetic field was examined by Rashidi et al. [6]. Akbar et al. [7] analyze the effects of radiation and convective boundary condition on MHD stagnation point flow of nanofluid past a stretching surface. The problem on a stretching surface has been discussed by several researcher in numerous different ways [8-12]. However, in certain cases it is necessary to consider unsteady flow and heat transfer over a stretching surface, which is stretched with a velocity that depends on time. The impact of unsteadiness parameter and Prandtl number on boundary layer flow and heat transfer characteristics had been discussed by Elbashbeshy and Bazid [13]. The results display the rate of heat transfer increases with the variation of unsteadiness parameter and Prandtl number. An analytical solution, using homotopy analysis method (HAM) is to investigate the unsteady MHD boundary layer flow of micropolar fluid between two radially stretching surfaces was obtained by Hayat et al. [14]. The influence of variable viscosity and thermocapillarity on unsteady shrinking sheet through porous medium has been considered by Nadeem and Awais [15]. Currently, Reddy et al. [16] have studied the effects of viscous dissipation and heat source on unsteady MHD flow over a stretching sheet. The first and second law of thermodynamics on