

Thermal radiation effects on MHD flow of a micropolar fluid over a stretching surface with variable thermal conductivity

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Abstract

In this paper, the effects of variable thermal conductivity and radiation on the flow and heat transfer of an electrically conducting micropolar fluid over a continuously stretching surface with varying temperature in the presence of a magnetic field are considered. The surface temperature is assumed to vary as a power-law temperature. The governing conservation equations of mass, momentum, angular momentum and energy are converted into a system of non-linear ordinary differential equations by means of similarity transformation. The resulting system of coupled non-linear ordinary differential equations is solved numerically. The numerical results show that the thermal boundary thickness increases as the thermal conductivity parameter S increases, while it decreases as the radiation parameter F increases. Also, it was found that the Nusselt number increases as F increases and decreases as S increases.

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1. Introduction

In many industrial manufacturing processes, the problem of flow and heat transfer in two-dimensional boundary layers on a continuous stretching surface, moving in an otherwise quiescent fluid medium, have attracted considerable attention during the last few decades. Examples may be found in continuous casting, glass-fiber production, metal extrusion, hot rolling, wire drawing, paper production, drawing of plastic films, metal and polymer extrusion and metal spinning [1–3]. Sakiadis [4] first presented boundary layer flow over a continuous solid surface moving with constant speed. This problem was extended by Erickson et al. [5] and Fox et al. [6] to include the wall suction or blowing and investigated its effects on the heat and mass transfer in the boundary layer. Crane [7] first studied the flow caused by an elastic sheet whose velocity varies linearly with the distance from a fixed point on the sheet. Gupta and Gupta [8] analyzed the heat and mass transfer corresponding to the similarity solution for the boundary layer over a stretching sheet subject to suction or blowing. Chen and Char [9] investigated the effects of the variable surface temperature and variable surface heat flux on the heat transfer characteristics of a linearly stretching sheet subject to blowing or suction.

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