



Thermal management of radiation mechanism over a stretchable curved surface inside the circle: performance enhancement of molybdenum disulfide and silicon dioxide hybrid nanofluid for thermal technology advancement

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ABSTRACT

The main perspective of this research focuses on addressing the pressing industry problem related to energy inefficiency by studying the heat transfer improvement of solar radiative and heat absorption/emission phenomena over a stretchable curved sheet inside the circle. To increase the model novelty, the combined influence of thermal relaxation, Newtonian heating, radiation mechanism, and Darcy-Forchheimer are included in the problem formulation of governing equations. Furthermore, this research employs the Cattaneo–Christov heat theory model to investigate the thermal flux via utilising the above-mentioned phenomenon with the purpose of advancing thermal technology. In this perspective, Molybdenum disulfide (MoS_2) with a base fluid of Propylene glycol ($C_3H_8O_2$) is utilised as nanoparticles for nanofluid (NFs), and for making hybrid nanofluid (HNFs), Molybdenum disulfide (MoS_2) and silicon dioxide (SiO_2) are utilised with of Propylene glycol ($C_3H_8O_2$). The equations are converted into ordinary Differential equations using Similarity variables. Shifted Legendre collocation scheme (SLCS) is then utilised to solve the simulation of the modelled equations. The findings show that the solar radiation effects boosted the heating performance of the $MoS_2 - SiO_2 / C_3H_8O_2$ hybrid nanofluid.

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KEYWORDS

Solar radiation effects; hybrid nanofluid; shifted legendre collocation scheme; heat absorption/emission; Darcy-Forchheimer

Nomenclature

R_1, R_2	Components
ϕ	Volume fraction
$\bar{T}$	Temperature of the surface
$\bar{T}_\infty$	Temperature far from the surface
Nr	Thermal Radiation
k_{nf}	Thermal conductivity of nanofluid
k_{hnf}	Thermal conductivity of Hybrid nanofluid
ρ_{nf}	Density of nanofluid
ρ_{hnf}	Density of hybrid nanofluid
$(\rho C_p)_{nf}$	Specific heat capacity of nanofluid
$(\rho C_p)_{hnf}$	Specific heat capacity of hybrid nanofluid
$\vartheta_{hnf} = \frac{\mu_{hnf}}{\rho_{hnf}}$	Kinematic viscosity of hybrid nanofluid
Fr	Darcy-Forchheimer Parameter
γ	curvature parameter,
Re	local Reynolds number
δ	heat generation
Pr	Prandtl number
ω	thermal relaxation
Bi	Newtonian heat parameter
MoS_2	Molybdenum disulfide
SiO_2	Silicon dioxide

1. Introduction

The immersion of nanoparticles into the regular heat transfer fluids developed new heat transfer fluids called nanofluids. Nanofluids are more useful rather than conventional fluids because in the synthesis of nanofluids, a stable suspension of solid nanoparticles is used in a regular fluid to improve the heat transfer activities. Recently, much research focused on hybrid nanofluids therefore these fluids make an advanced classification of conventional heat transfer fluids. These fluids have an exceptional thermophysical and rheological properties. For instance, the heat transfer performance of hybrid nanofluids is quite remarkable compared to traditional heat transfer fluids. One of the key reasons behind this is that the addition of nanoparticles increased the efficiency of conventional fluids therefore they exhibit better heat transfer performance in various applications (Huminic and Huminic 2018). In the synthesis of hybrid nanofluids, the concentration of nanoparticles can be fixed to achieve specific thermal and physical properties, which is why these fluids show long-term stability and customise hybrid nanofluids for different worthwhile applications. For example, heat engines (Bhattad et al. 2023) electronics cooling (Aglawe, Yadav, and Thool 2021), heat exchangers (Huang,