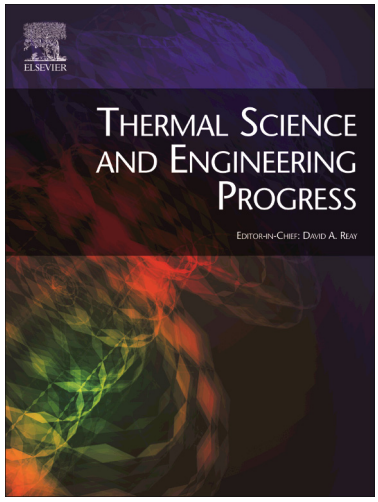

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PII: S2451-9049(17)30026-4
DOI: http://dx.doi.org/10.1016/j.tsep.2017.04.001
Reference: TSEP 15

To appear in: *Thermal Science and Engineering Progress*

Received Date: 15 February 2017
Revised Date: 12 April 2017
Accepted Date: 12 April 2017

Please cite this article as: L.M. Al-Balushi, M.M. Rahman, I. Pop, Three-dimensional axisymmetric stagnation-point flow and heat transfer in a nanofluid with anisotropic slip over a striated surface in the presence of various thermal conditions and nanoparticle volume fractions, *Thermal Science and Engineering Progress* (2017), doi: http://dx.doi.org/10.1016/j.tsep.2017.04.001

Three-dimensional axisymmetric stagnation-point flow and heat transfer in a nanofluid with anisotropic slip over a striated surface in the presence of various thermal conditions and nanoparticle volume fractions

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ABSTRACT

In this paper three-dimensional axisymmetric stagnation-point boundary layer flow of nanofluids over a striated surface with anisotropic slip is analyzed considering various thermal boundary conditions and nanoparticle volume fractions. The mathematical nanofluid model of Buongiorno has been used. Using appropriate similarity transformations, the basic partial differential equations are transformed into ordinary differential equations. These equations have been solved numerically for different values of the model parameters such as slip parameters ($0.1 \le \gamma_1 \le 10, 0.1 \le \gamma_2 \le 5$), Brownian diffusion parameter ($0.1 \le Nb \le 0.5$), thermophoresis parameter ($0.1 \le Nt \le 0.5$), surface convection parameter ($5 \le A \le 500$), Prandtl number ($\Pr = 6.8$), Lewis number ($Le = 10$), and stretching/shrinking parameter ($\lambda = -1, 0, 1$) using the bvp4c function from Matlab. The effects of these parameters on the shear stress, rate of heat transfer from the surface of the striated sheet to the fluid, Sherwood number, dimensionless velocity, temperature, and nanoparticles volume fraction distributions are presented in tables and graphs, and are in details discussed. Asymptotic analysis for the behavior of the solutions for large slip is conducted. The stability analysis of the problem guaranteed that the obtained solutions for different values of the anisotropic slip parameters are stable, hence physically realizable. The results show that the anisotropic slip (γ_i) on the striated surface significantly controls the shear stress, heat and mass transfers of a nanofluid. The results further show that better heat transfer rate in a realistic nanofluid can be achieved when a temperature gradient is created on the surface and the normal flux of the nanoparticles due to thermophoresis on it is zero.

Keywords: Nanofluid, convection, stagnation-point flow, striated surface, thermophoresis, Brownian diffusion

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