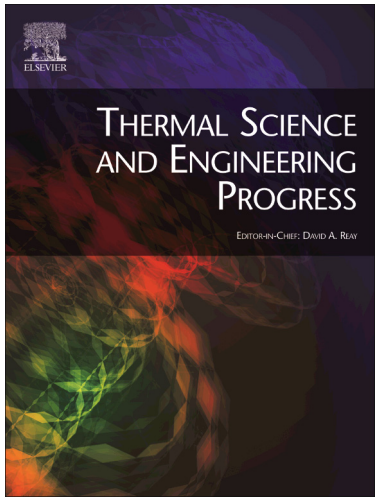

Numerical computation of natural convective heat transport within nanofluids filled semi-circular shaped enclosure using nonhomogeneous dynamic model

M.J. Uddin, M.M. Rahman

PII: S2451-9049(16)30020-8
DOI: http://dx.doi.org/10.1016/j.tsep.2017.02.001
Reference: TSEP 1

To appear in: *Thermal Science and Engineering Progress*

Received Date: 17 December 2016
Revised Date: 10 February 2017
Accepted Date: 11 February 2017

Please cite this article as: M.J. Uddin, M.M. Rahman, Numerical computation of natural convective heat transport within nanofluids filled semi-circular shaped enclosure using nonhomogeneous dynamic model, *Thermal Science and Engineering Progress* (2017), doi: http://dx.doi.org/10.1016/j.tsep.2017.02.001

Numerical computation of natural convective heat transport within nanofluids filled semi-circular shaped enclosure using nonhomogeneous dynamic model

M. J. Uddin and M. M. Rahman*

Department of Mathematics and Statistics, College of Science, Sultan Qaboos University, P.O. Box 36, P.C. 123, Al-Khod, Muscat, Sultanate of Oman

ABSTRACT

In this paper, the problem of unsteady natural convective flow of nanofluids inside a semicircular shaped enclosure using the newly developed nonhomogeneous dynamic model has been investigated numerically. The Galerkin weighted residual finite element technique has been employed to solve the governing nonlinear and coupled dimensionless partial differential equations. The streamlines, the isotherms, and the isoconcentrations are displayed graphically to show the flow and thermal fields as well as concentration levels of nanofluid. The average Nusselt numbers at the heated wall of the enclosure for 16 types of nanofluids are calculated for different flow parameters. Comparisons are made with the numerical as well as the experimental data available in the literature. The results show that nanoparticles uniformly suspend in a base fluid when the particle diameter ranges from 1-10 nm. The average Nusselt number increases significantly with the increase of the nanoparticle volume fraction as well as with different shapes of nanoparticles, whereas it decreases remarkably with the increase of nanoparticles diameter. It is noted that Cu-water and CuO-water nanofluids are the best performer to enhance heat transfer rates compared to the other nanofluids considered in the analysis.

Keywords: Nanofluids, nanoparticles, heat transfer, nonhomogeneous dynamic model, finite element method

1 Introduction

The word nanofluid was first proposed by Choi [1] about twenty years earlier. Nanofluids are produced by using the base fluids like water, ethylene glycol, engine oil, pump oil, glycerol, etc. and 1-100 nm size particles made from various material, for instance, oxide ceramics (Al_2O_3, CuO), nitride ceramics (AlN, SiN), carbide ceramics (SiC, TiC), metals (Cu, Ag, Au), semiconductors (TiO_2, SiC), carbon nanotubes, and composite materials such as alloyed nanoparticles ($Al_{70}O_{30}$) or nanoparticle core-polymer shell composites. In addition to nonmetallic, metallic, and other materials for nanoparticles, completely new materials and structures may also have desirable characteristics. Nanofluids have novel properties that make them potentially useful in many applications (see, Uddin

* Corresponding author: Email- mansurdu@yahoo.com, Fax: +968 2414 1490