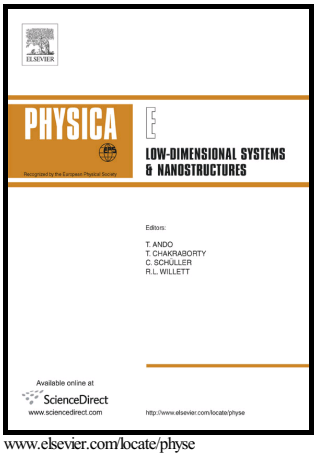
Numerical Simulation of Laminar Forced Convection of Water-CuO Nanofluid inside a Triangular Duct

Amir Aghanajafi, Babak Mehmandoust, Davood Toghraie



www.elsevier.com/locate/physe

PII: S1386-9477(16)30587-2
DOI: http://dx.doi.org/10.1016/j.physe.2016.08.022
Reference: PHYSE12555

To appear in: *Physica E: Low-dimensional Systems and Nanostructures*

Received date: 8 June 2016
Revised date: 7 August 2016
Accepted date: 17 August 2016

Cite this article as: Amir Aghanajafi, Babak Mehmandoust and Davood Toghraie Numerical Simulation of Laminar Forced Convection of Water-CuO Nanofluid inside a Triangular Duct, *Physica E: Low-dimensional Systems and Nanostructures,* http://dx.doi.org/10.1016/j.physe.2016.08.022

Numerical Simulation of Laminar Forced Convection of Water-CuO Nanofluid inside a Triangular Duct

Amir Aghanajafi[1], Babak Mehmandoust[1] , Davood Toghraie[1*]

[1]Department of Mechanical Engineering, Khomeinishahr Branch, Islamic Azad University, Khomeinishahr, Iran

[*]Toghraee@iaukhsh.ac.ir

Abstract

In this article, distilled water and CuO particles with volume fraction of 1%, 2% and 4% are numerically studied. The steady state flow regime is considered laminar with Reynolds number of 100, and nano-particles diameters are assumed 20 nm and 80 nm. The hydraulic diameter and the length of equilateral triangular channel are 8 mm and 1000 mm, respectively. The problem is solved for two different boundary conditions; firstly, constant heat flux for all sides as a validation approach; and secondly, constant heat flux for two sides and constant temperature for one side (hot plate). Convective heat transfer coefficient, Nusselt number, pressure loss through the channel, velocity distribution in cross section and temperature distribution on walls are investigated in detail. The fluid flow is supposed to be one-phase flow. It can be observed that nano-fluid leads to a remarkable enhancement on heat transfer coefficient. Furthermore, CuO particles increase pressure loss through the channel and velocity distribution in fully developed cross section of channel, as well. The computations reveal that the size of nano-particles has no significant influence on heat transfer properties. Besides, the study shows a good agreement between provided outcomes and experimental data available in the literature.

Keywords: Convective heat transfer coefficient, nano-fluid, Nusselt Number, Laminar flow

Nomenclature

c_p Specific heat [J/kgK]

d Diameter [m]

h Convective heat transfer coefficient [W/m^{2}K]

k_{eff} Conduction heat transfer coefficient [W/mK]

L Length [m]

N Avogadro number

Nu Nusselt number

p Pressure [Pa]