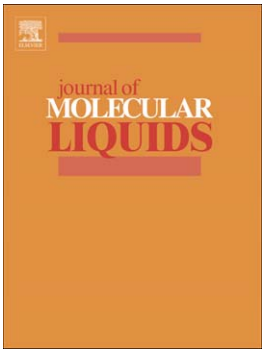

Three dimensional simulation of natural convection and entropy generation in an air and MWCNT/water nanofluid filled cuboid as two immiscible fluids with emphasis on the nanofluid height ratio's effects

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Three dimensional simulation of natural convection and entropy generation in an Air and MWCNT/water nanofluid filled cuboid as two immiscible fluids with emphasis on the nanofluid height ratio's effects

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Abstract

This paper reports a numerical study of the natural convection and entropy generation for a layered fluid system in a cuboid enclosure which is differentially heated from sides and filled by two immiscible gas/liquid fluids (air and MWCNTs-water nanofluid).This study emphasize on the effects of the liquid interface aspect ratio, solid volume fraction of nanofluid, and Rayleigh number on the fluid flow, heat transfer and entropy generation. The fluid flow streamlines, contours of local fluid friction irreversibility, temperature, and local heat transfer irreversibility in the 3D enclosure are obtained. The local and averaged Nusselt number and volumetric entropy generation are also discussed. The results show that the nanofluid interface aspect ratio has significant influences on the fluid flow, heat transfer performance and entropy generation. Moreover, it is shown that the total entropy generation and mean Nusselt number are reduced by increasing of nanofluid interface aspect ratio and are enhanced by increasing of Rayleigh number.

Keywords: Nanofluid; natural convection; entropy generation; immiscible fluids; MWCNTs/water

1. Introduction

Natural convection in cuboid enclosures has received significant attention due to wide important in engineering applications as electronic cooling equipment, solar collectors, double pane windows, Lead-Acid batteries and etc. [1-3]. However, due to the poor heat transfer performance of traditional fluids (e.g., water, oil and ethylene glycol), many considerable attractions have been devoted in order to improve their thermal conductivity by adding nanoparticles to fluids which are called as nanofluid. Accordingly, natural convection within rectangular/square cavities filled with nanofluids in 2D form was investigated by many researchers [4, 5]. There are large number of investigations which have considered natural convection in enclosures filled with single type of fluid, Hu et al. [6] and kefayati [7].Wei et al. [8] investigated the natural convection within a square cavity with different Rayleigh number. They applied Lattice Boltzmann method and the results show the natural convection mechanism with increasing of Rayleigh number. Dubois et al. [9]