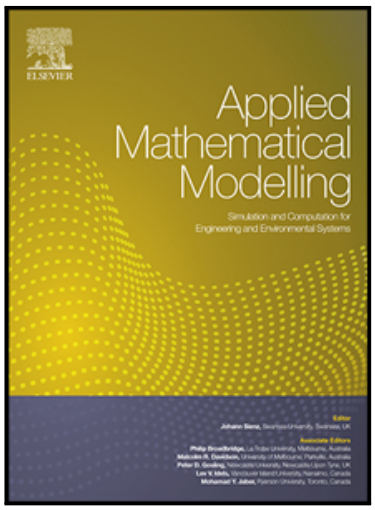

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Khaled Al-Salem

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Highlights

- The effect of adding an electric field is studied with combined buoyancy and thermocapillary effects.
- The electric forces can control the thermocapillary instabilities.
- Instabilities can be attenuated, or even completely eliminated by the electric field.
- The heat transfer can be improved with increases in T, Ra and Ma.

Electro-thermo-capillary-convection in a square layer of dielectric liquid subjected to a strong unipolar injection

Walid Hassen[a], Lioua Kolsi[b,a], Hakan F. Oztop[c,1], Abdullah A.AA Al-Rashed[d], Mohamed Naceur Borjini[a], Khaled Al-Salem[e]

[a] Unité de Recherche de Métrologie et des Systèmes Energétiques, Ecole Nationale d'Ingénieurs, 5000 Monastir, University of Monastir, Tunisia
[b] Department of Mechanical Engineering, College of Engineering , Haïl University, Haïl City , Saudi Arabia
[c] Department of Mechanical Engineering, Technology Faculty, Firat University, Elazig, Turkey
[d] Dept. of Automotive and Marine Engineering Technology, College of Technological Studies, The Public Authority for Applied Education and Training, Kuwait
[e] Dept. Mech. Engineering, College of Engineering, King Saud University, Riyadh, Saudi Arabia

Abstract

In this paper, the effect electric field on the flow induced by the combined buoyancy and thermocapillary forces is carried out. Calculations are performed for a strong unipolar injection (C = 10) and different values of Marangoni number ($-10000 \leq Ma \leq 10000$), thermal Rayleigh number ($5000 \leq Ra \leq 50000$) and electric Rayleigh number ($0 \leq T \leq 800$). The Prandtl number (Pr) and the mobility parameter (M) are fixed at 116.6 and 49, respectively. These values correspond to the Silicone oil used as working liquid several practical applications. The full set of coupled equations: Navier-Stokes, Electro-hydrodynamic (EHD) and heat transfer equations are directly solved using stream function–vorticity formalism. Obtained results show that the electric forces can control the thermocapillary instabilities. According to the intensity and the direction of the applied electric forces, it is demonstrated that these instabilities can be accentuated, attenuated, or even completely eliminated.

[1] Corresponding Author: E-mail: hfoztop1@gmail.com, Tel: 90 424 236 7064, Fax: 90 424 236 7064