Paper ID: 11901
oral

MICROGRAVITY SCIENCES AND PROCESSES (A2)
Fluid and Materials Sciences (2)

Author: Prof. Innocent Mutabazi
Université du Havre, France, mutabazi@univ-lehavre.fr

Dr. Satish Malik
University of Le Havre, France, satish.malik@univ-lehavre.fr
Dr. Olivier Crrumeyrolle
France, crumeyrolle@univ-lehavre.fr

THERMO-ELECTRO-HYDRODYNAMIC INSTABILITIES IN A DIELECTRIC LIQUID UNDER MICROGRAVITY

Abstract

We present recent results on the stability of a dielectric liquid in a cylindrical annulus with a coupled action of a radial alternating high voltage and a radial temperature gradient in microgravity conditions. The vorticity equation of such a flow exhibits a baroclinic force term that involves an electric gravity which decreases with the radial distance. This gravity is responsible of the buoyancy force (electric Archimedial force) under microgravity [1-3]. The problem of the thermal convection induced by electric gravity is investigated through linear stability analysis for an infitely long annulus and through direct numerical simulation for a finite-length annulus. We have determined critical parameters (electric Grashof number, wavenumber, frequency) as functions of electric voltage and temperature gradient. In particular, we have found that, for a finite length annulus, critical modes correspond to vortices aligned in the azimuthal direction (columns). We have computed the heat transfer for different values of temperature gradient and of the electrical voltage. Numerical results are compared with preliminary results of a parabolic flight experiment. These results are complementary to those available up to now in the literature[1-3]. [1]B. Chandra and D.E. Smylie, Geophys. Fluid Dyn. 3, 211(1972) [2]M. Takashima, Q.J. Mech. Appl. Math. 33, 93(1980) [3]M. Smieszek, O. Crumeyrolle, I. Mutabazi, C. Egbers, IAC-08-A2.2.9, Glasgow (2008).