MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Science Results from Ground Based Research (4)

Author: Prof. Antonio Viviani
Seconda Universita' di Napoli, Italy, antonio.viviani@unina2.it

Prof. Ilya Simanovskii
TECHNION - Israel Institute of Technology, Israel, yuri11@zahav.net.il
Mr. Frank Dubois
Université Libre de Bruxelles, Belgium, frdubois@ulb.ac.be
Prof. Jean-Claude Legros
Université Libre de Bruxelles, Belgium, jclegros@ulb.ac.be

# THE INFLUENCE OF AN INTERFACIAL HEAT RELEASE ON CONVECTIVE OSCILLATIONS IN TWO-LAYER SYSTEMS WITH PERIODIC BOUNDARY CONDITIONS

## Abstract

Convective phenomena in systems with interfaces has been a subject of an extensive investigation in the past few decades. Traditional fields of application of the interfacial convection are chemical engineering and materials processing. Among the modern techniques requiring an investigation of convection in systems with interfaces one can mention liquid encapsulation crystal growth technique used in space laboratories missions, droplet-droplet coalescence processes, where the Marangoni convection in the inter-droplet film can considerably affect the coalescence time during extraction, and others. It is known that the stability problem for the mechanical equilibrium in a system with an interface is not self-adjoint, thus an oscillatory instability is possible. The hydrodynamic and thermal interaction between convective flows on both sides of the interface can produce oscillations. There are various physical phenomena that can be the origin of a heat release on the interface. For example, the interfacial heat release accompanying an interfacial chemical reaction and the evaporation. The presence of a constant, spatially uniform heat release at the interface can also lead to the appearance of an oscillatory instability. In the present work, nonlinear oscillatory convective regimes, developed under the joint action of buoyant and thermocapillary effects in a two-layer system with periodic boundary conditions on the lateral walls, have been investigated. The wide range of the modified Grashof number values, corresponding to heat sources and heat sinks at the interface, has been considered. It is shown that in the case of periodic boundary conditions we get completely different nonlinear regimes than those, which have been obtained in the case of closed cavities. Specifically, regimes of traveling waves and modulated traveling waves, have been found. It is shown that for sufficiently small values of the modified Grashof number, corresponding to the case of heat sinks, the phase velocity of the traveling wave changes in a non-monotonic way. Nonlinear oscillatory flows exist in a finite interval of the Grashof number values, bounded from below and from above.