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

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STUDY ON TRANSITION PROCESS OF BUOYANT -THERMOCAPILLARY CONVECTION IN AN OPEN ANNULAR POOL

Abstract

Surface deformation, oscillatory behaviors, basic characteristics and transition process of the convection flow during the convection establishment and development, are known as essential topics on flow instabilities which is quite significant in coupling mechanism and theory exploration. Our experimental work mainly focus on the oscillation behaviors and transition issues. We have successfully captured the tiny micrometer wave signal of surface deformation generated from flow instabilities through a high-precision laser displacement sensor and proposed some results from spectrum, dimensionless and critical condition analysis with the aid of Labview software platform on high Pr number KF96-100 silicone oil. It is believed that there exists an oscillation zone which seems like a narrow band when Bo ¡3.7 while Bo¿ 3.7, the oscillation zone becomes wide which means easy to arouse. The roles of buoyancy can be opposite as the liquid layer thickness is increased to enhance the convection intensity, keeping the flow stable at the beginning but disturbing the flow conversely afterwards. Besides, we are also positive to say that the multi-frequency oscillation will come towards a higher order when the temperature difference is enlarged. Thinking about the universal existence of chaos among non-linear dynamic systems as annular pool system, Wolf's time evolution algorithm is rational utilized here to reconstruct the phase space of one-dimensional time series obtained in the experiments, so as to calculate the optimal delay time, embedding dimension and the maximum Lyapunov exponent. The non negative calculation results prove that our experimental system is chaotic. Different results with distinct beginning temperatures show the chaotic attractor is sensitive to initial condition. Finally with the space experiment project in progress, this paper also covers introduction of space payload design and related tests, including experimental scheme, functional and mechanical modeling, as well as thermo analysis of core components of the device.