原子能科学技术 2006 40 (2): 172-176 ISSN: 1000-6931 CN: 11-2044/TL

快报

自然循环欠热沸腾起始点特性

周 涛[1，2]，杨瑞昌[1]，刘若雷[1]

1.清华大学 热能系， 北京 100084 2.华北电力大学（北京） 动力系 核电教研室，北京 102206

收稿日期 2004-6-23 修回日期 2004-11-15 网络版发布日期: 2006-10-17

摘要 利用适于强迫循环的伯格尔斯和罗斯诺经验方法、Davis和Anderson理论方法，以及本课题组依据自然循环实验提出的预测欠热沸腾起始点的经验公式，对两种类型的欠热沸腾起始点的热力学平衡干度进行比较计算，研究自然循环的欠热沸腾起始点的基本特性。研究结果表明：自然循环欠热沸腾起始点的热力学平衡干度对加热量、进口温度、系统压力有着更大的敏感特性，在同等条件下，更早发生欠热沸腾现象。统计物理的微观角度研究进一步指出：产生这一现象的根本原因在于处于自组织状态的自然循环耗散结构的特点、动力学的涨落力和动量力对热力学平衡的共同影响。此研究结果为今后研究和应用自然循环的欠热沸腾奠定了基础。

关键词 自然循环；强迫循环；欠热沸腾；泡核沸腾起始点；干度

分类号 TL364

Characteristic of Onset of Nucleate Boiling in Natural Circulation

1.Department of Thermal Engineering, Tsinghua University, Beijing 100084, China; 2.North China Electric Power University, Beijing 102206, China

Abstract Two kinds of thermodynamics quality at onset of nucleate boiling with subcooled boiling were calculated for force circulation by using Bergles and Rohesenow method or Davis and Anderson method, and natural circulation by using Tsinghua University project group's empirical equations suggested in our natural circulation experiment at same condition. The characteristic of onset of nucleate boiling with subcooled boiling in natural circulation were pointed out. The research result indicates that the thermodynamics quality at onset of nucleate boiling with subcooled boiling in natural circulation is more sensitive for heat and inlet temperature and system pressure. Producing of onset of nucleate boiling with subcooled boiling is early at same condition. The research result also indicates more from microcosmic angle of statistical physics that the phenomena are caused by the effects of characteristic of dissipative structure of natural circulation in self organization, fluctuation force and momentum force of dynamics on thermodynamics equilibrium. These can lay good basis for study and application on subcooled boiling in natural circulation in future.

Key words natural circulation; force circulation; subcooled boiling; onset of nucleate boiling; quality

DOI

通讯作者