<<微细沸腾传递现象>>

图书基本信息

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前言

This book is based on the excellent fundamental research of Prof. X. F. Peng. Many unique micro transport phenomena during boiling with their corresponding mechanisms have been investigated. This will serve as a special reference for researchers interested in the field of microscale boiling.Boiling exists widely in the natural world, with boiling heat transfer has been employed in many practical applications. However, due to the highly nonequilibrium and coupled driven effects of the various physical potential, boiling heat and mass transfer is extremely complicated and many interesting phenomena are triggered under different specified conditions. Nowadays, therapid development of practical engineering applications of boiling in cooling of electronic devices, thermal management of aerospace and micro energy systems, and micro-manufacturing, promote a strong demand for better understanding of microscale transport phenomena and create a notable shift of thermal science and heat transfer research from macroscale to microscale. Consequently, in recent decades, more and more investigations have been conducted to explore the micro transport phenomena during boiling. This book reviews and summarizes the new achievements and contributions of recent investigations, including the outstanding fundamental research conducted by the writer and his co-authors. The fundamentals for conducting investigations on micro boiling, microscale boiling and transport phenomena, boiling characteristics at microscale, and some important applications of micro boiling transport phenomena are introduced and discussed.Chapter 1 introduces the background and industrial applications, as well as the research history of boiling, and then, the critical concept of "micro boiling" is described. In Chapter 2, some important thermal physics concepts and principles involved in boiling phenomena, such as phase and phase equilibrium, phase transition, interracial aspects, contact angle and dynamical contact behavior, and cluster dynamics are described in detail. Chapter 3 introduces new understandings of boiling nucleation and achievements in the latest 20 years.

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内容概要

作为热流体工程科学中最具挑战性的研究课题之一，沸腾现象在微型能源系统、微电子和发光二极管冷却、高密度紧凑式装置或系统、高热流密度散热和热管理等方面的应用，以及沸腾现象的复杂性和多样性一直受到高度关注，其物理本质的研究因而成为一大热点。

《微细沸腾传递现象》从微细尺度沸腾研究基础理论、沸腾的微尺度特征和理论、微尺度沸腾与传递现象的描述、微尺度沸腾传递的应用几个侧面分析这一领域的最新进展，系统地描述了这一现象并给出了基础理论的框架。

《微细沸腾传递现象》可供大学和研究院所力学、热物理、能源、微电子等专业的研究人员和本科高年级学生、研究生阅读参考。

作者简介

Dr. Xiaofeng Peng, who had passed away on Sep. lo, zoog, was a professor at the Department of Thermal Engineering, Tsinghua University, China.

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书籍目录

章节摘录

插图：A locally heated duct liquid flow usually has a fully-developed velocity profile and a developing thermal boundary, which could therefore be categorized as the thermal entrance problem, or the Graetz-type problem. [34] When heat flux within heated region increased to a value so that both fluid temperature and thermal layer thickness favored nucleation condition at some active locations, nucleate boiling began as shown in Fig. 6.15(a). From classical bubble dynamics theory, initial period of bubble growth should be inertia-controlled, shown bi-directional bubble growth along both the upstream and downstream direction to satisfy the pressure balance. Since the bubble was confined by small channel width, it was an elongated bubble or vapor column. The length of the elongated bubble increased until the pressure difference across the liquid-vapor phase interface reduced, and the interface movement decelerated. Then the bubble growth entered the heat transfer controlled period.In heat transfer control period, the upstream cap of the elongated bubble evaporated due to continuous heating from the channel wall. And highly energetic vapor generation pushed both the upper and lower caps moving further upstream and downstream, respectively. As the upper interface moved upwards into upstream subcooled liquid and even out of heating region, the interfacial temperature or liquid superheat for inducing evaporation would decrease, and the evaporation rate slowed. Finally the upstream cap stopped moving, as depicted in Fig. 6.15(b). The downstream cap of the bubble, on the other hand, left the locally heated region during its movement downwards, and superheated vapor started to condense on the relatively low temperature surface of the upper channel wall, or the Pyrex glass layer bottom (see Fig. 6.15(c)). Condensation continued until vapor was entirely consumed, and liquid single phase flow recurred.

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编辑推荐

《微细沸腾传递现象》：Micro Transport Phenomenz Duritzg Boiling reviews the new achievements and contributions in recent investigations at microscale, lhe content mainly includes (i) fundamentals for conducting investigations of micro boiling, (ii) microscale boiling and transport phenomena, (iii) boiling characteristics at microscale, (iv) some important applications of micro boiling transport phenomena. This book is intended for researchers and engineers in the field of micro energy systems, electronic cooling, and thermal management in various compact devices/systems at high heat removal and/or heat dissipation.

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