

多相流和计算流体力学

微小有限空间内微气泡控制生长的界面追踪与数值模拟

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摘要

通过对微机电系统微流体器件中气泡生长实验结果的分析, 考虑加热元表面液体微层的作用, 将微气泡生长分为晶核形成、球形气泡、受侧壁挤压的气泡、沿微通道生长的气泡4个阶段, 建立了矩形微通道内微气泡控制生长物理模型; 采用Level Set Method模拟了矩形微通道内微气泡控制生长过程, 获得了微气泡生长特性。数值模拟结果表明: 微气泡初期生长速率较快, 后期由于凝结率增大使生长速率减缓; 液体温度、微通道宽度、微加热元宽度、加热电压等均对气泡生长始点和生长速率有显著影响。

关键词

[微机电系统](#) [微流体相变](#) [微气泡生长](#) [Level Set Method](#) [微小有限空间](#)

分类号

Interface tracking and numerical simulation of micro-bubble controlled growth in micro restrained space

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Abstract

Based on the experimental results of micro-bubble controlled growth in MEMS(micro-electro-mechanical system) devices, the bubble growth process could be divided into four stages, namely, nucleating, spherical bubble, bubble restrained by lateral wall, bubble elongating along the channel. A physical model of micro-bubble growth in the rectangular microchannel was established by considering the micro layer of liquid in the heater. Numerical simulation of micro-bubble growth in the micro restrained space was performed by the Level Set Method and the characteristics of micro-bubble growth were obtained and analyzed. The simulated data showed that micro-bubble grew rapidly in the early stage but grew slowly in the late stage due to the increasing condensation rate on the interface. The results also indicated that the initial temperature of liquid, width of the microchannel, width of the microheater, and the heating voltage had remarkable effects on the bubble inception and bubble growth rate.

Key words

[MEMS](#) [microfluidic phase change](#) [micro-bubble growth](#) [Level Set Method](#) [micro restrained space](#)

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