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传递现象

矩形微通道中环状冷凝的三维数值模拟

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摘要

建立了恒热流边界条件下矩形微通道中环状冷凝过程的三维模型。通过求解气相和弯月面区动量和质量方程及薄液膜厚度方程，得到了弯月面毛细半径分布、冷凝液膜厚度分布，以及传热系数和壁面温度分布。薄液膜区液膜将沿程逐渐增厚，到达一极值后再逐渐变薄。在通道截面中，薄液膜区的传热系数大于弯月面，最大局部传热系数及壁面最高温度皆位于薄液膜区和弯月面的连接处。[JP2]在冷凝起始段，通道横截面平均传热系数沿程急剧减小至一极值;在此之后的很长一段距离内，则基本保持不变;[JP]直至接近环状冷凝终点时又再次沿程减小。

关键词

矩形微通道 环状冷凝 数值模拟

分类号

Three dimensional simulation for steady annular condensation in rectangular microchannels

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Abstract

A three dimensional model in rectangular microchannels with constant heat flux was developed to predict the steady annular condensation.The momentum and mass conservation equations both in the vapor and meniscus regions and the film thickness equation in the thin film region were numerically solved.The distribution of the meniscus curvature radius, thickness of the thin liquid film, heat transfer coefficient and wall temperature were obtained.The film thickness in the thin film region increased in the head stream to a maximum, and then decreased in the downstream.The average heat transfer coefficient in the thin film region was much larger than that in the meniscus.The highest heat transfer coefficient in a cross section appeared at the joint of the thin film region and meniscus, where wall temperature was the highest.The circumferential average heat transfer coefficient decreased drastically at the head stream to a lowest value.After that, the circumferential average heat transfer coefficient remained almost constant while approaching the end of the annular flow, then it decreased again.

Key words

rectangular microchannel annular condensation simulation

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