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不同压力差下微通道尺寸和表面粗糙度对摩擦系数的影响

刘赵淼,逄燕

北京工业大学机电学院, 北京 100124

INFLUENCES OF SIZE AND ROUGHNESS OF MICROCHANNELS ON FRICTION FACTORS UNDER DIFFERENT PRESSURES

LIU Zhao-miao,PANG Yan

College of Mechanical Engineering and Applied Electronics Technology, Beijing University of Technology, Beijing 100124, China

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摘要 该文数值模拟液体在圆形和梯形截面微通道内的流动,分析了层流和湍流下液体在微圆管内的流动状态。着重研究不同压力差、微通道尺寸和表面粗糙度下,液体在微通道内的流动摩擦系数,并通过摩擦系数随雷诺数的变化曲线推断微通道流动转捩的雷诺数范围。研究表明:微通道中流动的摩擦系数随雷诺数的增大逐渐减小;通道截面的当量直径会改变过渡状态存在的雷诺数范围;粗糙度会影响湍流状态下流动的摩擦系数,相同雷诺数下,粗糙度越大,摩擦系数越大。

关键词: 微通道 液体流动 数值模拟 摩擦系数 粗糙度

Abstract: The characteristics of liquid flow in the microchannels with circular and trapezoidal cross-sections were studied by numerical simulation. The friction factor of liquid flow in microchannels was investigated with different pressures, the sizes and roughness of microchannels. The different flow regimes of laminar and turbulence were also analyzed in the microtubes. In addition, the range of a transition Reynolds number can be inferred from the friction factor profiles under different Reynolds numbers. The friction factors in the microchannels decrease with the increasing of Reynolds numbers gradually. The Reynolds number at transition from laminar to turbulent flow changes with the cross-section’s equivalent diameter. At the same Reynolds number, the friction factor increases with the roughness of the inner wall of the microchannel when the flow is turbulent.

Key words: microchannel liquid flow numerical simulation friction factor roughness

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作者简介: 逄 燕(1986-),女,山东诸城人,硕士生,从事微流体力学研究(E-mail: caibing@emails.bjut.edu.cn).

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[1] 尹执中, 胡桅林, 过增元. 微流动系统的发展概况[J]. 流体机械, 2000, 28(4): 33-37. Yin Zhizhong, Hu Weilin, Guo Zengyuan. Review on microflow devices and systems [J]. Fluid Machinery, 2000, 28(4): 33-37. (in Chinese)

[2] Qi S L, Zhang P, Wang R Z, Xu L X. Single-phase pressure drop and heat transfer characteristics of turbulent liquid nitrogen flow in micro-tubes [J]. International Journal of Heat and Mass Transfer, 2007, 50(9/10): 1993-2001.

[3] 郝鹏飞, 何枫, 朱克勤. 微管道内湍流转捩的实验研究[J]. 工程力学, 2006, 23(增刊I): 30-34. Hao Pengfei, He Feng, Zhu Keqin. Experimental study of transitional and turbulent flow in a microtube [J]. Engineering Mechanics, 2006, 23(Sup. I): 30-34. (in Chinese)

[4] 刘赵淼, 张谭. Laval 型微喷管内气体流动的计算及分析[J]. 航空动力学报, 2009, 24(7): 1556-1563. Liu Zhaomiao, Zhang Tan. Numerical investigation on gas flow in Laval micronozzle [J]. Journal of Aerospace Power, 2009, 24(7): 1556-1563. (in Chinese)

[5] 陶文铨, 王良璧, 曾敏. 传热与流动问题的多尺度数值模拟: 方法与应用[M]. 北京: 科学出版社, 2008. Tao Wenquan, Wang Liangbi, Zeng Min. Heat transfer and flow problems of multi-scale numerical simulation: Methods and applications [M]. Beijing: Science Press, 2008. (in Chinese)

[6] Bahrami M, Yovanovich M M, Culham J R. A novel solution for pressure drop in singly connected microchannels of arbitrary cross-section [J]. International Journal of Heat and Mass Transfer, 2007, 50(13/14): 2492-2502.

[7] 文书明. 微流边界层理论及其应用[M]. 北京: 冶金工业出版社, 2002. Wen Shuming. Micro-flow boundary layer theory and its application [M]. Beijing: Metallurgical Industry Press, 2002. (in Chinese)

[8] Shah R K, London A L. Laminar flow forced convection in duct [M]. New York: Academic, 1978.

[1] 朱劲松,朱先存. 钢筋混凝土桥梁疲劳累积损伤失效过程简化分析方法[J]. , 2012, 29(5): 107-114,121.

[2] 董志强,徐进良. 微通道人工空穴汽泡核化跃离的lattice Boltzmann模拟[J]. , 2012, 29(5): 219-223.

[3] 王周;李朝晖;龙桂华;高琴;赵家福. 求解弹性波有限差分法中自由边界处理方法的对比[J]. , 2012, 29(4): 77-83.

[4] 颜卫亨;邰家醉;张茂功. 野营折叠网壳结构表面定常风场的数值模拟研究[J]. , 2012, 29(4): 224-230.

[5] 支旭东;聂桂波;范峰. 大连市体育馆圆钢管相贯节点足尺实验研究[J]. , 2012, 29(3): 170-176.

[6] 叶红玲;郑小龙;沈静娴;刘赵淼. 液体静压导轨转台轴向振动的动力学建模与分析[J]. , 2012, 29(3): 218-225.

[7] 许和勇;叶正寅;张伟伟. 基于非结构自适应网格技术的高超声速流动数值模拟[J]. , 2012, 29(3): 226-229,.

[8] 喻葭临;于玉贞;张丙印;吕禾. 土坡中剪切带形成过程的数值模拟[J]. , 2012, 29(2): 165-171.

[9] 孔晓鹏;蒋志刚;晏麓晖;陈斌. 陶瓷复合装甲粘结层效应和抗多发打击性能的数值模拟研究[J]. , 2012, 29(2): 251-256.

[10] 杜修力;曹惠;金浏. 力-变位关系全过程模拟的有限元位移控制新方法[J]. , 2012, 29(1): 1-6.

[11] 熊益波;陈剑杰;胡永乐;王万鹏. 混凝土Johnson-Holmquist 本构模型关键参数研究[J]. , 2012, 29(1): 121-127.

[12] 阳洋;Khalid M Mosalam;金国芳;刘荷. 基于改进直接刚度法的加州某桥梁结构损伤评估研究[J]. , 2012, 29(1): 114-120,.

[13] 李 易;陆新征;任爱珠;叶列平;陈适才. 某八层混凝土框架结构火灾连续倒塌模拟[J]. , 2011, 28(增刊I): 53-059.

[14] 牛琪瑛;刘建君;张 明;刘少文. 碎石桩加固液化砂土地基的数值模拟分析[J]. , 2011, 28(增刊I): 90-093.

[15] 曹 鹏;冯德成;田 林;荆儒鑫. 基于弹塑性损伤理论的水泥稳定基层养生期裂缝形成机理分析[J]. , 2011, 28(增刊I): 99-102,.

地址：北京清华大学新水利馆114室 邮政编码：100084

电话：(010)62788648 传真：(010)62788648 电子信箱：gclxbjb@tsinghua.edu.cn