具穿孔障礙塊之方形渠道熱流特性實驗研究

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摘 要

本研究利用暫態液晶法完成具階梯障礙塊、穿孔障礙塊之方形管道其障礙塊前、後之熱傳係數之細 部測定。變動之參數包括雷諾數與階梯障礙塊之高度、不同孔數，結果顯示障礙塊前端會因流動之 衝擊效應，造成局部熱傳增益，此效應在雷諾數愈大或障礙塊愈高時愈明顯，而障礙塊下游在中心 線兩側比中心區有較佳之熱傳係數，顯示氣流通過障礙塊後，於中心線兩側形成兩道二次流。 由實驗驗證零件經常被局部高溫燒壞，而不是被整個過高的水平溫度燒壞。在障礙塊前壁面受到熱衝 擊效應，最容易產生積熱。穿孔數目若能均勻分布在障礙塊壁面，延長元件壽命。當氣體穿過愈多孔 的障礙塊時，氣體流過多孔洞重新接觸後，會產生較多紊流造成系統熱傳係數較平均，對於整個系統 而言是有利的。

關鍵詞 : 暫態液晶法、穿孔障礙塊、管道流、階梯障礙塊、雷諾數

目錄

參考文獻

[1]R.J. Moffat, "Experimental Heat Transfer," Keynote Paper, KN11, Proc. 9th Int. Heat Transfer Conf., Jerusalem, 1990,Vol.1, pp. 882-890.

[2]T.E. Cooper, R.J. Field and J.F. Meyer, "Liquid Crystal Thermography and Its Application to the Study of Convective Heat Transfer," ASME, Journal of Heat Transfer, 1975, pp.442-450.

[3]J.C. Simonich and R.J. Moffat, "Liquid Crystal Visualization of Surface Heat Transfer on a Concavely Curved Turbulent Boundary Layer," Journal of Engineering for Gas Turbulent and Power, 1984, Vol.106, pp.619-627.

[4]P.T. Ireland and T.V. Jonse, "The Response Time of Surface Thermometer Employing Encapsulated Thermochromic Liquid Crystals," Journal of Physics E, 1985, Vol 20, pp 1195-1199.

[5]J.W. Baughn and D.B. Markel, "Improvements in a New Technique for Measureing and Mapping Heat Transfer Coefficients," 1986 Rec. Sci. Instrum., Vol.57, No.4, pp.65-654.

[6]A. Hoffs, A. Bolcs and S. P. Harasgama, "Transient Heat Transfer Experiments in a Liner Cascade Via An Insertion Mechanism Using the Liquid Crystal Technique," , 1995, ASME 95-GT-8.

[7]C. Camci, K. Kim and S.A. Hippensteele, "A new hue capturing technique for the quantitative interpretation of liquid crystal image used in convective heat transfer studies," ASME, J. Turbomachinary, 1992, Vol.114, pp.765-775.
[8]Von Wolfersdorf, R. Hoecker and T. Sattelmayer, "A Hybrid Transient Step-Heat Transfer Measurement Technique Using Heater Foils and Liquid Crystal Thermography, " ASME, Journal of Heat Transfer, 1993, Vol.115, pp.319-324.
[9]Z. Wang, P.T. Ireland, T.V. Jones and R. Davenport, "A Color Image Processing System for Transient Liquid Crystal Heat Transfer Experiments," ASME, Journal Turbomachinery, 1996, Vol.118, pp.421-427.
[10]J.C. Han and S.V. Ekkad, "Turbine Blade Cooling and Heat Transfer Measurement Using a Transient Liquid Crystal Image Method," Invited Paper for the 5th Cooling on Turbomachinery Seoul National University Seoul, Korea, 1996, pp.263-302.
[11]J.W. Baughn, J.E. Mayhew, M.R. Anderson and R.J. Butler, "A Periodic Transient Method Using Liquid Crystals for the Measurement of Local Heat Transfer Coefficients," ASME, Journal of Heat Transfer, Technical Notes, 1998, Vol.120, pp.772-777.
[12]J.W. Baughn, P.T. Ireland and N. Sanniei, "A Comparison of the Transient and Heatrd-Coating Methods for the Measurement of Local Heat Transfer Coefficients on a Pin Fin," Journal of Heat Transfer, 1989, Vol. 111, pp.877-881.
[13]W.H. Schofield and E. Logan, "Turbulent Shear Flow Over Surface Mounted Obstacle," ASME J. Fluids Engineering, 1990, Vol.112, pp.376-385.
[14]B.H. Kang and Y. Jaluria, "Mixed Convection Transport from a Protruding Heat Source Module on a Vertical Surface," AIAA, Journal of Thermophysics and Heat Transfer, 1990, Vol.4,pp.384-390.
[15]E.R. Meinders, T.H. Van DerMeer and K. Hanjalic, "Local Convective Heat Transfer form an Array of Well-Mounted Cubes," Int. J. Heat Transfer, 1998, Vol.41, No.2, pp.335-346.
[16]Hiroshi Iwai, Kazuyoshi Nakabe and Kenjiro Suzuki, "Flower and Heat Transfer Characteristics of Backward-Facing Step Laminar Flow in a Rectangular Duct," Int. J. Heat and Mass Transfer, 2000, Vol.43, pp.457-471.
[17]J. T. Yang and C. H. Tsai, "Transient Effect of Micro-Jet Cooling on a Flat in Separated Flow Field," Proceedings of the Eleventh International Symposium on Transport Phenomena, Hsinchu, 1998,Taiwan, R.O.C., November 29-December 3, pp. 278-282.
[18]J. T. Yang, B. B. Tsai and G. L. Tsai, "Separated-Reattaching Flow over a Backstep with Uniform Normal Mass Bleed," J. Fluid Eng., 1994,Vol.116,29-35.
[19]W. Nakayama and S.H. Park, "Conjugate Heat Transfer from a Single Surface-Mounted Block to Forced Convective Air Flow in a Channel," ASME, Journal of Heat Transfer, 1996, Vol.118, pp.301-309.
[20]葉兆雄，"外在裝置對大型積體電路流場之影響"，國立成功大學工程科學研究所，1990。
[21]M.K. Chyu and V. Natarajan, "Local heat/mass transfer distributions on the surface of a wall-mounted cube," ASME J. Heat Transfer, 1991, Vol.113, pp.851-857.
[22]I.S. Kinnear, A.L. May and R.A. Wall, 1980, "Secondary Control in Axial Fluid Machine," UK Patent Application GB 2 042 675 A".
[23]Y.P. Gan, Q.J. Deng, C.F. Ma, X.Y. Yuan and D.Y. Cai, "Forced convection air cooling from electronic component arrays in a parallel plate channel," IEEE Transactions On Components, Packaging, and Manufacturing Technology, 1996, Part A, Vol.19, No.2, pp.163-167.