سامية محمد مصطفى

شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

سامية محمد مصطفى

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

سامية محمد مصطفى

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

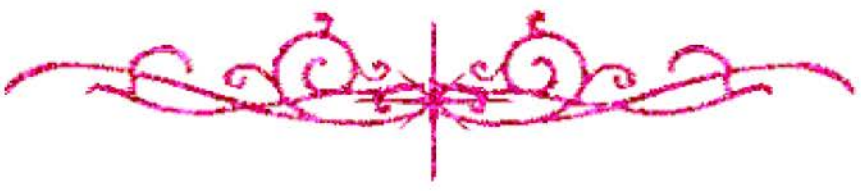
يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

سامية محمد مصطفى

شبكة المعلومات الجامعية

بعض الوثائق الأصلية تالفة



سامية محمد مصطفى

شبكة المعلومات الجامعية

بالرسالة صفحات لم ترد بالأصل

Mansoura University
Faculty of Engineering
Mechanical Power Eng. Dept.

Heat Transfer in Microchannels

Thesis
Submitted in Partial Fulfillment of Requirements
for the Master Degree in Mechanical Power Engineering

By
Eng. Hossam Saad El-Dein Saleh
B.Sc. of Mechanical Power Engineering
Mansoura University

Supervisors

Prof. Dr. Mohamed Mahgoub
Prof. of Mechanical Power Eng. Dept.,
and Vice Dean of Faculty
of Engineering, Mansoura University

Prof. Dr. Mohamed-Nabil Sabry
Prof. of Mechanical Power Eng. Dept.,
and Dean of Faculty of Engineering,
Université Française d'Egypte

Dr. Berge Djebedjian
Faculty of Engineering
Mansoura University

2004

Mansoura University
Faculty of Engineering
Mechanical Power Engineering Department

Approval Sheet

This is to approve that the dissertation presented by

Eng. Hossam Saad El-Dein Saleh to Mansoura University entitled:

"Heat Transfer in Microchannels"

for the degree of Master of Engineering Sciences (**Mechanical Power Engineering**) has been approved by the examining committee.

Examining Committee	*Signature*
Prof. Dr. Sameer Mohammed Abdel-Ghany Prof. of Mechanical Power Eng. Dept., Faculty of Engineering, Ain Shams University.	
Prof. Dr. Mahmoud Mostafa Awad Prof. of Mechanical Power Eng. Dept., Faculty of Engineering, Mansoura University.	
Prof. Dr. Mohamed Mahmoud Mahgoub Prof. of Mechanical Power Eng. Dept., and Vice Dean of Faculty of Engineering, Mansoura University. **(Supervisor).**	
Prof. Dr. Mohammed Nabil Sabry Prof. of Mechanical Power Eng. Dept., and Dean of Faculty of Engineering, Université Française d'Egypte. **(Supervisor).**	

12/7/2004

Supervision Committee

Thesis Title: **Heat Transfer in Microchannels**

Researcher Name: **Hossam Saad El-Dein Saleh**

Supervision Committee

No	Name	Job	Signature
1	Prof. Dr. Mohamed Mahgoub	Prof. of Mechanical Power Eng. Dept., and Vice Dean of Faculty of Engineering, Mansoura University.	
2	Prof. Dr. Mohamed-Nabil Sabry	Prof. of Mechanical Power Eng. Dept., and Dean of Faculty of Engineering, Université Française d'Egypte.	
3	Dr. Berge Djebedjian	Mechanical Power Eng. Dept. Faculty of Engineering Mansoura University	

Head of Mechanical Power Engineering Department

Vice Dean of Graduate Studies, Research and Cultural Affairs

Dean of Faculty

Examining Committee

Thesis Title: **Heat Transfer in Microchannels**

Researcher Name: **Hossam Saad El-Dein Saleh**

Supervision Committee

No	Name	Job
1	Prof. Dr. Mohamed Mahgoub	Prof. of Mechanical Power Eng. Dept., and Vice Dean of Faculty of Engineering, Mansoura University.
2	Prof. Dr. Mohamed-Nabil Sabry	Prof. of Mechanical Power Eng. Dept., and Dean of Faculty of Engineering, Université Française d'Egypte.
3	Dr. Berge Djebedjian	Mechanical Power Eng. Dept. Faculty of Engineering Mansoura University

Examining Committee

No	Name	Job
1	Prof. Dr. Samir Abdel-Ghany	Prof. of Mechanical Power Eng. Dept., Faculty of Engineering, Ain Shams University.
2	Prof. Dr. Mahmoud Awad	Prof. of Mechanical Power Eng. Dept., Faculty of Engineering, Mansoura University.
3	Prof. Dr. Mohamed Mahgoub	Prof. of Mechanical Power Eng. Dept., and Vice Dean of Faculty of Engineering, Mansoura University.
4	Prof. Dr. Mohamed-Nabil Sabry	Prof. of Mechanical Power Eng. Dept., and Dean of Faculty of Engineering, Université Française d'Egypte.

Head of Mechanical Power Engineering Department

Vice Dean of Graduate Studies, Research and Cultural Affairs

Dean of Faculty

Acknowledgement

Thanks to GOD the merciful, who guided me along the years until this work was accomplished.

The author wishes to express his sincere gratitude for Prof. Dr. Mohamed-Nabil Sabry, Prof. Dr. Mohamed Mahgoub, and Dr. Berge Djebedjian for their supervision and valuable advices during the work.

May all who helped me in preparing the manuscript also receive my deep gratitude.

Abstract

The use of microchannels in order to cool modern high speed electronic circuits is one of the techniques frequently adopted in current practice. A burst of publications in this area has been observed in the last decade. However, modeling of fluid flow and heat transfer in microchannels is still an open problem. In fact, many deviations have been experimentally observed between well established correlations used for conventional normally sized channels and the behavior of microchannels. These deviations increase as the channel size decreases. Observed experimental deviations will first be listed, followed by a critical review of different hypotheses advanced in the literature to explain them. One of these hypotheses will be thoroughly studied in order to build a model that explains both the orders of magnitudes and the trends of observed phenomena.

In this work, detailed analysis of fluid flow and heat transfer over three subsequent roughness elements is made. Incompressible unsteady state continuity, Navier-Stokes, and energy equations are solved using the finite element method and assuming that the fluid flow is two-dimensional for simplicity. The effect of roughness on the flow and heat transfer is studied in details for different Reynolds numbers. The results show that the tendency to separation and formation of a low pressure zone between roughness elements take place at relatively low Reynolds numbers and small hydraulic diameters. This gives a better estimate of fluid flow and heat transfer in microchannels including the dependence of flow characteristics on the Reynolds number in laminar flow as well as the early transition to turbulence.