UNIVERSITY of HOUSTON

CULLEN COLLEGE of ENGINEERING

MECHANICAL ENGINEERING

Wednesday, July 29, 2020

2:00 PM

Defense held online via Zoom

Masoumeh Nazari

PhD Dissertation Defense

Dr. Hadi Ghasemi, Faculty Advisor

"On Physics of Fluid Transport and Phase Change in Nanoconfinements"

Abstract

Understanding the underlying physics of fluid behavior at nanoconfined geometries is essential to address many common challenges existing in science and engineering applications such as nanomedicine, energy conversion and storage, water purification, membrane science and electronics/photonics cooling. As the confinement dimensions shrink to nanoscale, the role of fluid/wall interactions as well as surface forces become more significant in the transport phenomena. These interactions result in the properties and behavior of the nanoconfined fluid to deviate considerably from those of the bulk, so that the classical theories no longer hold. In this dissertation, our focus is to study fluid behavior in nanoconfinements in the context of fluid transport and phase change. To this end, we developed nanofluidic devices, which consist of 2-D planner nanochannels with a height ranging from 180 nm to 10 nm, on silicon ship through the MEMS fabrication techniques. The simple and deterministic structure of our developed devices allow us to investigate the validity of classical equations and hydrodynamic properties at the nanoscale, to recognize the source of deviation, and to explore atypical phenomena (physics) emerging at this scale, such as extremely high evaporative heat flux, formation of interfacial viscous layer, breakdown of capillary wicking and the concept of surface tension nanogates.

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