BIOGRAPHICAL SKETCH

Farzin Mashali was born in Shiraz, Iran, on July 8, 1991 but lived in Ahwaz until 2010 when he moved to Tehran to start his B.S. degree in Chemical Engineering at Sharif University of Technology. He graduated from Sharif University in the spring of 2015.

In January 2017, he joined the Mechanical Engineering program at Tennessee Tech University, and started working in the collaborative project on nanodiamond fluids between Tennessee Tech, Vanderbilt University and International Femtoscience, Inc. He completed all the requirements for his Maters of Science degree in March 2019.

EDUCATION

M.S., Mechanical Engineering, Tennessee Technological University, Cookeville, Tennessee, USA. 2017-2019

B.S. Chemical Engineering, Sharif University of Technology, Tehran, Iran. 2010-2015

College of Engineering

TENNESSEE TECH

The Department of

Mechanical Engineering

Announces the Thesis Defense

of

Farzin Mashali

In Partial Fulfillment of the Requirements

For the degree of

Master of Science in Mechanical Engineering

Wednesday, March 27, 2019
10:30 a.m.

Held in

241 Brown Hall
115 West 10^{th} Street
Cookeville, TN, 38505

FIELD OF STUDY

Mechanical Engineering

Thermal and Fluid Science

DISSERTATION TOPIC

Deaggregated and Functionalized Nanodiamond Fluids for Thermal Management

EXAMINING COMMITTEE

Dr. Ethan Languri, Chairperson
Mechanical Engineering Department

Dr. Glenn Cunningham
Mechanical Engineering Department

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Mechanical Engineering Department

Dr. Jimmy Davidson
Vanderbilt University

ABSTRACT

Suspensions of ultra-fine nanoparticles which have thermal conductivities orders of magnitude higher than those of the conventional base fluids have been widely studied to take advantage of the high heat-transfer capability of their solid particles in a fluid with lower thermal properties. Particulate de-aggregated and functionalized nanodiamond is used in this study as a low-concentration additive to traditional heat-transfer fluids to determine how it enhances the fluids' thermal conductivity and, hence, heat-transfer capability, while attempting not to majorly disrupt existing pressure drop or loop maintenance. It will be determined how critical sufficient de-aggregation and compatible functionalization chemistry of the nanodiamond are to successful outcomes. The tested functionalized nanodiamond fluids are prepared specifically so that the functional group's terminal chemical bond couples with the host matrix, resulting in their operational improvement.

In this thesis, particular experimental approaches have been chosen to appraise the effectiveness of the processes of de-aggregation and surface functionalization on nanodiamond. The appraisal starts with thermo-structural characterization of the samples as well as thermal conductivity and viscosity measurement as those are the most important fluid properties that can be amplified by adding nanoparticles. Particle-size distribution, zeta potential, and electrical conductivity are the other factors examined in nanodiamond suspension samples. An experimental heat transfer apparatus can realistically evaluate whether the particular nanodiamond suspension can be applied in electronic cooling applications with components that may be used in the real process. The results indicate that the heat-transfer coefficient enhancement, which leads to energy savings, is more than what is shown in the literature data at the same pumping power.