FIELD OF STUDY

Chemical Engineering

DISSERTATION TOPIC

Electrokinetic-Based Microflows in Capillaries Of Axially-Varying Rectangular Geometry- Selected Applications In Microfluidics And Biomedicine

EXAMINING COMMITTEE

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ABSTRACT

The analysis of electrokinetic-based transport in axially varying sections of capillaries is far from being complete and in need of further studies. In this project, we propose to conduct a fundamental analysis for a divergent-type of capillary of rectangular geometry in order to gain understanding of the capillary behavior of different situations. These include for example, the possibility that the capillary charges on the walls have different signs, that the applied electric fields could be either constant in time (DC) or periodic in nature (AC) and that the flows could be either constant or transient. The analysis can be performed by following the guidelines of the electrokinetic hydrodynamic (EKHD) framework and the illustration and justification of assumptions can be made within those typically used within the domain of the continuum mechanics approach. The relevance of the effort in quite impactful and far reaching areas of applications in clinical diagnostics, cancer detection (by using protein tracers), and electro-treatment of tumors, among others. The main focus of application, however, is a novel cancer treatment termed, Tumor Treating Fields Therapy (TTF). The model presented here will serve as a foundation that may be built upon in the future to further understand how cytoplasm, as well as microtubules and macromolecules, are behaving inside a tumor cell when this therapy is applied. Assumptions are applied in this work in order to simplify the equations and allow for obtainable results, these assumptions can later be taken out to develop a more realistic model for the TTF application, and the parameters can be altered in order to apply this model to multiple other applications as mentioned. The overall goal is to bring together the fundamental principles of fluid mechanics, electrokinetics, and conservation of momentum to apply to a potential real-world application.

BIOGRAPHICAL SKETCH

Leora Elizabeth Maxwell Loftis was born and raised on a farm in Cookeville, Tennessee. She attended elementary and middle school at Algood Elementary in Algood, Tennessee. Leora graduated from Cookeville High School with an honors diploma in May 2007. In the summer of 2012, Leora began her college career as a chemical engineering student. Her junior year she became involved in undergraduate research. She presented her work at multiple conferences, both regional and national, and received an award for her poster at the American Institute of Chemical Engineers National Conference in Atlanta, Georgia in October 2014. In April 2015 she received the Rising Renaissance Engineer award from the College of Engineering at Tennessee Tech, as well as the Outstanding Senior award from the College of Engineering. Leora received her Bachelor of Science in May 2015 and began her graduate degree work the following fall semester.

EDUCATION

B.S., Chemical Engineering

Tennessee Technological University, 2015-2017

College of Engineering

TENNESSEE TECH

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