GRADUATE STUDENT RESEARCH SEMINAR SERIES (2019)

NANOPARTICLE ENRICHMENT USING ELECTROTHERMAL FLOWS CAUSED BY JOULE HEATING EFFECT IN A DIELECTROPHORETIC MICRODEVICE

SPEAKER: AMIR MALEK

Dielectrophoresis has become a popular method for particle manipulation in microfluidic devices. This method requires an electric field gradient within the microchannel which can be created using constrictions inside the channel. However, these insulating structures will amplify a phenomenon known as the Joule heating effect. This effect is a result of the non-uniform electric field around the insulators in iDEP microdevices. The Joule Heating phenomenon results in temperature gradients within the fluid, which in turn induces gradients in temperature-dependent fluid properties such as electric conductivity, dielectric permittivity, and dynamic viscosity. These property gradients will cause a regional fluid flow known as electrothermal flow in the form of vortices. As shown via this work, the electrothermal flow vortices can be utilized to entrain nanoparticles for a localized enrichment near the insulating tips of a ratchet microchannel. The effect of different parameters such as electric field, time and particle size on the enrichment has also been evaluated. Finally, a numerical simulation is presented, which is able to predict the obtained experimental results with a good agreement.

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