Electrospun nanofiber mat as an electrode for dielectrophoretic trapping of nanoparticles

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Abstract

Dielectrophoresis (DEP) is a way to translate polarizable particles when subjected to a non-uniform electric field. This project uses electrospinning to create conductive nanofiber mats that will significantly increase the DEP force exerted on the particles by increasing the gradient of the electric field squared. Electrospinning is a straightforward way to produce a 3D mesh of conductive nanofibers that avoids complex and expensive microfabrication processes. First, conductive nanofibers are made from electrospinning of polyacrylonitrile in the N, N-dimethyl formamide solution and added fillers such as carbon nanotubes to increase conductivity. The carbonization of fibers at around 800°C transforms them into carbon nanofibers with diameters between 300-600nm and an electrical conductivity between 2-5 S/cm. This mat (one electrode) was placed on top of an indium tin oxide (ITO) electrode (another electrode) with around 150 µm gap in between them using micromanipulator. A welled silicone rubber is placed on top of ITO to hold the liquid inside it. Fluorescent nanoparticles suspended in DI water were trapped on the fiber mat. Positive and negative DEP were observed at lower (kHz) and higher (MHz) frequencies, respectively. This preliminary work successfully demonstrates conductive nanofibers can trap particles using DEP. Future work will focus on high throughput trapping of nanoparticles.

Biography of Presenter

Tonoy K. Mondal is a Ph.D. candidate and Graduate Fellow at the University of Louisville's Mechanical Engineering department. He is working with the Integrated Microfluidics Systems Laboratory under the supervision of Dr. Stuart J. Williams, Associate Professor of Mechanical Engineering. He is working with electrokinetic manipulation & separation of particles and cells using electrospun nanofiber mats. His current research also deals with microfabrication of microfluidic devices.