SEMINAR ANNOUNCEMENT

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Enginnering nanofibrous materials for micro and nanofluidics

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Abstract

Recent advances in manufacturing nanoporous fibers and electrospun nanowebs from various polymer precursors and carbon nanotubes make possible the development of novel micro- and nano-fluidic devices. Nanofibrous composite substrates possess a hierarchical pore architecture with high surface area and open porosity. This provides a significant absorption capacity and selective permeability. We discuss the principles of fluid pumping through fiber-based micro- and nano-fluidic devices exploiting the phenomenon of spontaneous absorption of wetting fluids by porous materials. Capillarity facilitates the droplet self-propulsion without the need for any additional external means. We will show that the size of the microchannels does matter. In some microchannels, the fluid velocity may be as fast as 100 cm/s! Fast capillarity-driven absorption of microdroplets allows one to distinguish the conformational changes of various biopolymers, for example DNA hybrids, via their viscoelastic response. This effect can be used in biosensors and analytical microfluidic devices for biopolymer recognition.

Driven by the idea to speed up the transport in fiber-based microfluidic devices, we describe a new method of controlled manipulation of micro-quantities of fluids by using a conduit formed by fiber rails. In these conduits, the droplet spreading and gathering back is controlled by changing the inter-fiber spacing. Compared to conventional microchannel design, the suggested fiber-based conduits significantly reduce the viscous drag and can be constructed from available microfibers of different cross-sectional shapes. We discuss some applications of the proposed concepts to fiber-based micro-and nanofluidics for electrochemical biosensors. Electrospun nanowebs and fibers made of single wall carbon nanotubes will exemplify the concepts.

Bio:

Dr. Konstantin Kornev graduated from the Department of Mechanics and Mathematics at

Kazan State University (KSU) in Russia in 1988. From 1988 to 1990 he worked at the Institute of Mechanics and Mathematics at KSU. In 1990 he has been invited to occupy the research position at the Institute for Problems in Mechanics, RAS, the leading institution of the Russian Academy of Sciences in the field of mechanics. In parallel, he worked as the Associate Professor of Physics at the University of Aircraft Technnology in Moscow. He joined the Textile Research Institute in Princeton, NJ in 2000. Dr. Kornev is an expert in Hele-Shaw flows, flows through porous media, phase transitions in forced flows, flow and rheology of complex fluids, and micro and nanofluidics. He has written the monograph *Kornev K.G. Foams in Porous Media*, Moscow, Fizmatlit, 2001 and has authored more than 60 technical papers and one US patent. Currently, he is working on manufacturing nanofibrous materials and applications of these materials to micro and nanofluidics.