Nanotubes: Forming and Medical Applications

Alexander Yarin

Mechanical and Industrial Engineering, University of Illinois at Chicago, Chicago, USA

Carbon nanotubes are synthesized and self-assembled via co-electrospinning, emulsion electrospinning, or template electrospinning and subsequent carbonization. Then, controlled flows through macroscopically long (~1 cm) carbon nanotubes are demonstrated. It is shown that a higher flow rate of liquid in a bi-layer gas-liquid system can be achieved as compared to the case when the same liquid flows through the same tube subjected to the same pressure drop and occupies the whole bore. This means that it is possible to release more liquid than predicted by the Poiseuille law, even though in the bi-layer flow liquid does not occupy the whole cross-section. This paradoxical result is related to the fact, that the less viscous gas layer can flow much faster than the underlying liquid layer and entrain the latter via a significant shear stress. This quasi-giant-slip phenomenon occurs in relatively large nanotubes (of the order of 500 nm dia.) where the no-slip condition holds with sufficient accuracy. This phenomenon can be beneficial in reverse osmosis systems. In addition, parallel bundles of these carbon nanotubes are used as nanoreactors to polymerize sufficiently monodisperse thermo-responsive nanoparticles of the order of 400 nm dia. at the rate of 107 particles per sec. Nanoparticles of this size are therapeutically beneficial and can be used as drug carriers. Controlled release from them modulated by temperature variation was demonstrated. Application of the solution blown soy protein monolithic and core-shell nanofibers will be described.