

Conference abstract L02

Nanofibers, nanofluidics, nanoparticles and nanobots for drug and protein delivery systems

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Several inter-related issues relevant for the development of novel drug delivery systems are covered in the talk. They encompass:

(i) *Release from electrospun nanofibers*. The present work shows that solid-state diffusion may not be the primary mechanism at play. In such cases the release rate of low molecular weight compounds can be explained by desorption of the embedded compound from nanopores in the fibers, or from the outer surface of the fibers. In addition, the desorption-limited release mechanism is supported by the results for release of two model protein (high molecular weight) compounds from electrospun polycaprolactone (PCL) nanofiber mats. The studied compounds were bovine serum albumin (BSA) and an anti-integrin antibody (AI). The results are consistent with protein release mechanism dominated by desorption from the polymer surface.

(ii) *Nanofluidics for long-term drug delivery*. Macroscopically long bundles of parallel straight carbon nanotubes/nanopores produced by either co-electrospinning or the nanofiber template casting method were studied as possible tools for this purpose. These nanopores have diameters in the range of about 300 nm to 1 μm and lengths up to 1 cm.

(iii) Nanochannels were also used to polymerize sufficiently monodisperse monolithic and core-shell *thermo-responsive Poly(N-isopropyl acrylamide) (PNIPAM) nanoparticles* of the order of 400 nm dia. at the rate of 10^7 particles per sec. During their formation, the nanoparticles were loaded with a model fluorescent admixture to study its encapsulation in these promising drug carriers. The release kinetics from the nanoparticles was studied under the conditions of thermal stimulation.

(iv) Filling nanotubes with low molecular weight fluids or particles is a challenge faced in numerous applications. We recently discovered that self-sustained diffusion at room temperature and atmospheric pressure in a droplet of dilute polymer solution or nanoparticle suspension allows for intercalating several-micron-long nanotubes with polymers, surfactants and nanoparticles with no harm for biologically active species. The method also allows for intercalating nanotubes with drugs sealing them with NIPAM-based thermo- and pH-responsive caps. This allows, in principle, creating *nanobots*: nanotubes intercalated with anti-cancer drugs, which release them only near a tumor in response to pH stimulus, since tumors and inflamed places are typically more acidic (pH 6.5) than normal tissues (pH 7.4).