Comprehensive toxicity evaluation of carbon nanoparticles

Engineered nanomaterials (ENM) represent a potentially serious challenge to public health as very little is known about their short- or long-term effects *in vivo*. Carbon nanotubes or nanofibers (CNTs, CNFs) are the most widely studied ENM in both industry and academia. This is due to their increasing use in composite manufacturing that creates potential for exposures having long-term cardiopulmonary effects. In spite of this, we lack a sophisticated quantitative understanding of physicochemical determinants of toxicity. New methods allowing measurement and prediction of toxicity and risk assessment at the cell and tissue levels are desired.

To address this, we use nanochannel-electroporation (NEP) capable of delivering nanoparticles with intracellularly into individual cells with precise dose control. The basic element of NEP consists of two microchannels connected by a nanochannel. The cell to be transfected is positioned in one microchannel adjacent to the nanochannel. The opposing microchannel is filled with solution containing ENMs at a known concentration. A millisecond voltage pulse between the two microchannels causes localized, intracellular transfection. NEP provides unique opportunities for quantitative studies of CNTs/CNFs cytotoxicity at the single cell level and stark contrast with standard systemic, membrane-based exposures.

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