# Fundamental Nano-Bio Science based on biomimetic engineering and microfluidic technology

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Engineered nanomaterials for the diagnosis and treatment of cancer have attracted enormous interest in the past decades. A wide range of nanomaterials have been developed for cancer therapy, ranging from inorganic, organic, polymer particles to lipids, proteins and other synthetic compounds. However, only a few cancer nanomedicines have been approved by the FDA (notably Doxil and Abraxane). This demonstrates the huge gap between laboratory research and clinical translation of cancer nanomedicines, mainly due to the incomplete understanding of the complex interactions between nanoparticles and the biological systems (at all levels from cells through to tissue and organs) is lacking. My research focuses on the development of novel nanosytems and new platform technologies based on biomimetic engineering and microfluidic technology for investigating the complex interactions between nanoparticles and biological systems [1-5]. We developed a biomimetic approach for making liquid-filled silica nanocapsules (SNCs, ~150 nm) using designed proteins and peptides. The stiffness of these nanocapsules can be tuned from Young's moduli of kPa to GPa. Using this nanosystem, we demonstrate a complex trade-off between nanoparticle stiffness and the efficiencies of both immune evasion and passive/active tumor targeting. [2]. We also developed microchip-based models (Tumor-on-a-Chip, Tumor-Vasculature-on-a-Chip) [6-8] that mimic tumors and tumor microenvironment for exploring nanoparticle extravasation from blood circulation, tumor accumulation and retention of nanoparticles at the tumor site, and the effect of leaky tumor vessels and extracellular matrix on nanoparticles' extravasation and accumulation. These studies improve our understanding of the fundamental nano-bio science and provide new design rules for future nanomedicine development.

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