Micro/nanoengineering tools for stem cell culture, functional immunophenotyping, and capture of circulating tumor cells

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Micro/nanoengineering systems are emerging as powerful high-throughput tools for quantitative analysis of cellular functions at the single-cell level. In this talk, I will discuss my group's research efforts in three different relevant areas: 1) Developing synthetic micro/nanoscale ex vivo microenvironment to direct stem cell behaviors and further employing them to identify the extrinsic physical factors and their downstream signaling pathways that regulate stem cell functions; 2) Creating novel microfluidic cellular functional immunophenotyping devices that can achieve rapid, accurate, and sensitive cellular functional assays on different types or subpopulations of immune cells isolated directly from blood specimens; 3) Fabricating nanoroughened surfaces for efficient capture of circulating tumor cells (CTCs) from blood specimens without using any capture antibody. Our method uniquely utilizes the differential adhesion preference of cancer cells to nanorough surfaces when compared to normal blood cells and thus does not depend on their physical size or surface protein expression, a significant advantage as compared to other existing CTC capture techniques.