Yale Institute for Nanoscience and Quantum Engineering

Friday, November 18, 2011

12:00 to 1:00 p.m.

MASON LAB
9 Hillhouse Avenue, ML211
Light lunch will be served at 11:45 a.m.

Professor Dan Prober
Department of Applied Physics
Faculty of Arts and Science, Yale University

" Microwave studies of Ultrasensitive Superconducting Detectors and Single-walled Carbon Nanotubes"

We have studied the electron energy loss processes in very sensitive superconducting nanobolometers and in single-walled carbon nanotubes of very high quality. The superconducting detectors can be used for very sensitive astronomy light sensors in the far-infrared region of the spectrum, and could be used in future NASA satellites. While their science is still being established, the nanotubes might also be made into sensitive detectors. We have studied the electron energy loss and Terahertz resonances of the nanotubes, to probe the novel one-dimensional (Luttinger liquid) picture of their properties.

Assistant Professor Rong Fan
Department of Biomedical Engineering
School of Arts and Science, Yale University

" Nanowire Arrays for Rare Cell Analysis"

Quantitation and comprehensive analysis of cellular biomarkers such as antigen-specific T cell subtypes and circulating tumor cells from peripheral blood is of great clinical value for early detection and stratification of complex human diseases, e.g. cancer and AIDS. But such analysis remains a grand challenge due to the rarity and intrinsic heterogeneity of these cells. Here we present a nanowire array-enabled laser scanning imaging cytometry for rare cell capture and analysis, which represents the first attempt towards quantitative, automated, and functional evaluation of blood-borne cellular biomarkers. Immuno-functionalized nanowire arrays were demonstrated as a superior material to capture rare cells from heterogeneous cell populations. The laser scanning cytometry method enables large-area, automated quantitation of captured cells and rapid evaluation of functional cellular parameters (e.g. size, shape and protein levels) at the single cell level. Using human lung carcinoma cells as a model, our technology quantitatively identified a four-fold enhancement in capture efficiency as compared to the planar substrate-based conventional imaging cytometry. In the settings of complex biospecimens such as lung carcinoma cells mixed with white blood cell lines or even spiked in the whole peripheral blood mononuclear cell pool, the nanowire substrate shows excellent capture efficiency and reasonably good purity. We further demonstrated it is possible to push the limit of detection to a few tumor cells. Using a high content image analysis algorithm, cellular morphometric parameters can be extracted. This platform enables informative functional analysis of captured rare cells *in situ* for potential subclassification of CTCs, a key step towards the identification of true metastasis-initiating cells. We also extend this platform to quantitation of CD4+ T cells and other rare immune cells. This nano-enabled platform may have important clinical values to analyze rare cellular biomarkers in clinical specimens for differential diagnosis and informative immune monitoring.

HOST: Professor Mark Reed