Fluidic Assembly and Interfacial Science of Nanoscale Devices for Electronics and Medicine

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ABSTRACT

Abstract: In this talk I will give an overview of the research in my group on the self-assembly and characterization in the three thrust areas dealing with nanoscale and sub nanoliter volume devices.

1) Fluidic self assembly and nanomanufacturing: Our group has developed techniques to permanently bond nanoscale components using adhesives and solder to form (insulating and conductive) integrated networks and 3D structures. I will discuss exploration of the use of 2D and 3D networks for nanoelectronics and sensing applications in order facilitate ultrasensitive (and selective) detection as well as to develop a 3D spatial sensor for sensing gases, biochemical agents and neurotransmitters.

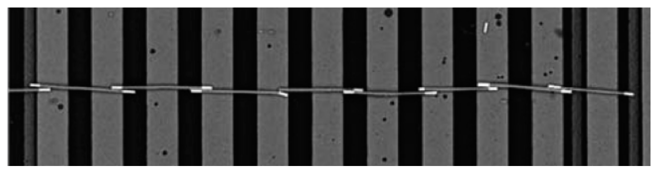

Fig. 1 Nanowire networks assembled on microfabricated contact pads.

2) 3D sub nanoliter volume containers for biomedical applications: I will discuss our invention of a new class of self-assembled encapsulation devices for cells and chemicals. These devices are three dimensional (3D) nanoliter containers that were fabricated by a novel process that included microlithography and self-assembly. The containers that resemble tiny boxes, can be loaded with cells, beads and chemicals, and can be guided and tracked in concealed microfluidic channels using magnetic resonance imaging (MRI). We are exploring the use of these containers in cell encapsulation therapy and radio frequency (RF) remote controlled chemistry.

Fig. 2 3D self-assembled micro containers with controlled porosity for cell encapsulation and chemical delivery.

3) Non-linear optical spectroscopy of interfaces: Sum frequency generation (SFG) vibrational spectroscopy is a monolayer sensitive non linear optical technique, is non-destructive and does not require vacuum operation. I will discuss one experiment in which we combined the SFG system with a four point electrical probe station to simultaneously measure for the first time, surface spectra and electronic properties in thin film (50 nm) organic semiconductor field effect transistors (OFETs) in-situ during operation.

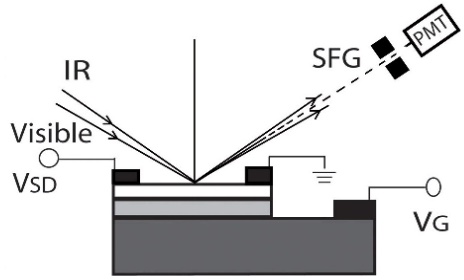

Fig. 3 In-situ SFG vibrational spectroscopy and electrical characterization of organic field effect transistors during operation.