University of Texas at San Antonio

Department of Physics & Astronomy

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Time: 3:00 p.m.-4:00 p.m.

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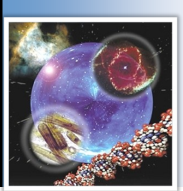
Novel Functionalities: Photons to Promote Actuation in Smart Materials and Ion Beams to Manufacture Biomedical Tools

Discovery of novel functionalities deployable in unconventional settings holds the key to improved convergence of the nano-bio-info-cogni quartet. These discoveries will build a paradigm shift towards an unprecedented, non-incremental advancement of the physical, medical, social, and cognitive sciences. On those lines, we present two novel functionalities. The first is ascribed to the framework of smart sensors and actuators; and the second, to the use of micro manufacturing ion beams in a previously unvisited context: the biomedical field.

Novel functionality in nano-optical mechanical actuation resides on nanotube-enriched polymeric materials. In this scheme, light sources promote mechanical actuation producing a variety of nano–optical mechanical systems (NOMS) such as artificial muscles or tactile displays for the visually impaired. These smart materials present a unique opportunity in a variety of fields, as sensors or actuators, from robotics to microfluidics; as well as energy scavenging and vibration control. However, fundamentals of photoactuation are not well understood. We propose to examine photoactuation of polymer-carbon nanotube (CNT) composites by in-situ Transmission Electron Microscopy (TEM) to elucidate fundamentals of photoactuation down to the atomic level. To provide a mechanistic description, the standing linear elastic model aiming at correlating nano and macro actuation will be reviewed, and variations in the treatment such as compressibility and non-linearity will be discussed.

Novel functionalities in the medical and biological fields are much sought-after given the increased interest in cell handling and sub-cellular monitoring. Indeed, cell handling has become a crucial procedure in cell biology; with scenarios ranging from nuclear transfer to DNA injection, and assisted reproduction. However, most pipette manufacturing procedures involve tedious artisanal methods, which are prone to failure and limit operation. In this work, Focus Ion Beam (FIB) micromachining is explored as an innovative technique to manufacture highly customized pipettes. FIB-sharpened micropipettes and glass capillaries successfully penetrated membranes of mouse oocytes and embryos, in the absence of piezo-drills. Initial findings suggest biocompatibility; paving the way to the introduction of ion beam milling techniques in the biomedical device arena.



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