ISEN EQUIPMENT AWARD Report:
August 2012 to July 2013

(Upgrade of Bruker Dimension ICON AFM with Scanning Capacitance Microscope)

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The upgraded system was installed on Bruker ICON system in August 2012 after it got delayed by few months. The purpose of this upgrade was to enhance the electrical and electrochemical measurements capabilities of the system that can have significant application in energy and data storage. Some of the applications of this upgrade involves mapping the dopant profile in a semiconductor and organic devices on a 10 nm scale, quantification of the local dielectric properties in low and high-k dielectric films, direct carrier distribution in layered structures and the study of the room temperature resonant electronic structure of individual nanostructures with different shapes. NIFTI Center currently have over 400 users using basic and advanced capabilities of the ICON system and this acquisition have provided the quantitative electrical measurements to several users within Northwestern, in Midwest community and International organizations. NIFTI provided training to 32 users during the last 10 months since this upgrade was installed.
and is currently serving these users in their electrical measurements. The system was applied to a wide variety of several research applications need such as:

- Used for organic solar cell films, where one component is p-type and the other component is n-type (usually C60 derivative). The p-type materials form usually fibers, in that case and it is not too difficult to identify the phases but we also have the ones which does not make. In such cases this technique was used to differentiate between two phases, but also understand the local electrical properties in the microstructure, and such an understanding will help to further optimize the morphology.
- Wide ride of capacitance and dopant profiling measurement were carried out piezoactuators for energy storage and ZnO nanorods for photovoltaics applications.
- Surface charges in graphene oxide polymer nanoassemblies for high density energy storage
- Surface charge densities of conducting polymers
- Dielectric properties of interfaces and thin films
- Electrical properties of embedded carbon nanotubes in polymer matrix
- Electrical conductivity of genetically engineered polypeptides for molecular interconnects
- Collaborators from Nanyang Technological University utilize Scanning capacitance and electrochemical microscopy for several energy related research projects. The system was heavily used to study the manganese oxide micro-supercapacitors with ultra-high areal capacitance.