

Ion Beam Lithography Employing a Multi-Species Focused Ion Beam System for Materials Processing and Graphene Formation

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The use of focused ions beams has mostly been limited to materials characterization and sample preparation, with few groups exploring the use of focused ion beams in materials processing and modifications. One impediment to expanding the role of focused ion beams in materials processing has been the limited ion species availability, namely only gallium. The University of Florida Nanoscience Institute for Medical and Engineering Technologies (NIMET) has collaborated with Raith to develop a version of the Raith ionLiNE IBL system that has the capability to deliver multi-ion species in addition to the Ga ions normally available. The system is currently equipped with a AuSi liquid metal alloy ion source (LMAIS) and ExB filter making it capable of delivering Au and Si ions and ion clusters for ion beam processing. This system is capable of high performance ion beam lithography, sputter profiling, maskless ion implantation, ion beam mixing, and spatial and temporal ion beam assisted writing and processing over large areas (100 mm²) – all with selected ion species at voltages from 15 – 40 kV and nanometer precision.

This presentation will discuss the performance of the system with the AuSi LMAIS source and ExB mass separator. We will report on initial results from the basic system characterization, ion beam lithography, submicron materials processing as well as basic ion-solid interactions. In addition, we report on an approach we have developed that combines ion implantation doping, annealing, and multi-ion beam lithography (MIBL) to both pattern and synthesize graphene nanostructures on SiC at lower temperatures when compared to conventional graphene on SiC formation from thermal annealing.