Nanofabrication with a Neon Ion Beam

Huimeng Wu, David Ferranti, Lewis Stern, John Treadgold and Chuong Huynh

Carl Zeiss Microscopy, LLC, One Corporation Way, Peabody MA 01960, Huimeng.Wu@zeiss.com

Joseph Myers, Erik Mccullen

IBM Essex Juntion, VT 05452

The Orion plus helium ion microscope (HIM) offers sub-nanometer spatial resolution imaging as well as precise ion machining and nanofabrication capabilities because the probe size of a He ion beam can be brought to as small as 0.25 nm. Studies have successfully demonstrated the various applications using this powerful tool such as He ion beam lithography, fabrication of solid-state nanopores for biomolecule detection, patterning on graphene, plasmonic devices, imaging of shale and coal for oil and gas recovery and He ion beam chemistry for semiconductor circuit edit. New application areas will continue to be explored. Although a He ion beam has been demonstrated to fabricate sub-10 nm structures, it is limited by its very low material removal rate. Recently, we developed a Ne ion beam in the ORION NanoFab platform. A neon ion beam offers precise nanofabrication capabilities, and 25~35 times higher sputter yields than a He ion beam. The direct He ion milling tests on a gold substrate show that the minimum line width is 4~5 nm, while Ne ion beam is about 8~9 nm. This presentation will show three nanofabrication examples obtained with direct-write using a Ne ion beam. The first example is fabrication of a nanostructure using the combination of He and Ne ion beams. The second example is milling high aspect ratio vias. The third one is a precise nano-surgery on a circuit device with good end-point signal using a Ne ion beam, including: cutting metal line, drilling vias to expose to/cut buried metal lines.