CNST collaboration demonstrates nanoscale focused ion beam employing laser-cooled lithium atoms

December 15 2011

(PhysOrg.com) -- A team of researchers from the NIST Center for Nanoscale Science and Technology and FEI Company have adapted a commercial focused ion beam (FIB) column to use photoionized laser-cooled lithium atoms as an ion source, and demonstrated that NIST's patented Magneto-Optical Trap Ion Source (MOTIS) offers imaging performance competitive with the liquid metal ion sources used in most FIBs.

In a MOTIS, a gas of atoms is laser-cooled to ≈ 100 μK and then photoionized. The ions are accelerated to the desired energy, forming a highly monochromatic beam that is amenable to nanoscale focusing when provided as input to a commercial focused ion beam column. The light mass and low surface sputtering rate of laser-cooled lithium allowed the researchers to demonstrate non-destructive imaging with a characteristic focal spot size of 26.7 nm ± 1.0 nm at 2 kV.

As predicted theoretically, the focal spot size was shown to depend on the temperature of the laser-cooled atoms and on the ion beam energy. The researchers anticipate further improvements to the system spot size for enhanced imaging. These results demonstrate that NIST's new ion source may enable a wide range of new applications — from nanoscale imaging and defect metrology to ion implantation and material modification.

More information: Nanoscale focused ion beam from laser-cooled lithium atoms, B. Knuffman, A. V. Steele, J. Orloff, and J. J. McClelland, *New Journal of Physics* 13, 103035 (2011). iopscience.iop.org/1367-2630/13/10/103035/