Electron-beam induced deposition and etching using liquids: A path to nanoscale rapid prototyping with functional materials

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Abstract

Focused electron-beam induced processing (FEBIP) enables the direct deposition and etching of functional materials with nanoscale resolution. The process has found application in integrated circuit edit and mask repair, nanoscale rapid prototyping, and interconnection to chemically synthesized nanostructures. FEBIP is traditionally conducted with gas-phase reactants, but recently researchers have investigated the use of bulk liquids as alternatives. These are introduced into electron microscopes using sealed cells, liquid injectors, or other environmental configurations. Liquid precursors promise deposition of a wider range of nanostructured materials with properties closer to those obtained from physical deposition or chemical synthesis. Liquid etchants enable the removal of materials that do not have volatile reaction products and may increase etch selectivity between different materials. Finally, many questions remain surrounding the mechanisms by which the energetic electrons drive local deposition and etching. This presentation will highlight the advantages of liquid reactants and provide evidence for the reaction mechanisms with a particular emphasis on processing of copper nanostructures.

Biography of Presenter

J. Todd Hastings is Reese S. Terry Professor of Electrical Engineering at the University of Kentucky where he also serves as Director of the Center for Nanoscale Science and Engineering. His research focuses on nano-scale electronic, photonic, and magnetic devices and their associated fabrication technologies. Prior to his current appointment he received the Ph.D. degree in Electrical Engineering from the Massachusetts Institute of Technology, the M.S. degree in electrical engineering from Purdue University, and the B.S. degree in physics from Centre College in Danville, Kentucky. He is the recipient of the NSF CAREER Award and the DARPA Young Faculty Award, and served as the chair of the 59th International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication.