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Projection Ion Beam Lithography System*

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Abstract

Maskless ion beam lithography schemes have been developed at Lawrence Berkeley National Laboratory (LBNL) for future integrated circuit manufacturing, thin film media patterning, and micromachining. The Maskless Micro-Ion-Beam Reduction Lithography (MMRL) system completely eliminates the first stage of the conventional IPL tool, that contains the ion beam illumination column before the stencil mask and the mask itself. It consists of a large area RF-driven multicusp plasma source, a multi-beamlet pattern generator, and an all-electrostatic ion optical column. Removing the use of stencil masks from the lithographic process would result in enormous cost savings. The use of an electronic pattern generator would also offer improved flexibility for rapid implementation of new designs and higher throughputs due to time savings from the elimination of multiple mask steps. We have performed exposure study on PMMA and Shipley UVII-HS resists by using 75 keV H+ or He+ ion beams. Tremendous work has been performed to improve the resolution, including adding limiting apertures, eliminating the dc magnetic field effect, getting rid of gas impurities etc. Feature size smaller than 50 nm has been achieved on PMMA resist exposure. Micro-beam extraction and switching through a multi-layer array of nine 50 micro-apertures together with 10X reduction have been demonstrated. Different pattern generator configurations are now being investigated so as to demonstrate maskless ion beam projection lithography.

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