Extreme Ultraviolet Holographic Lithography

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In this research, we report the initial results from a novel holographic lithography technique using Extreme Ultraviolet (EUV) radiation- EUV-HL. Extreme Ultraviolet Lithography (EUVL) is being developed to support the fabrication of sub-50nm electronic devices. Today, only few exposure tools are in existence due to the combined requirements of source, complex reflective mask and reflective imaging optics. Undulator insertion devices on a synchrotron are ideal EUV sources: they have high-brightness, are tunable and exhibit good spectral and temporal coherence [1]. Undulator sources have indeed been used to characterize EUV optics [2], and wavefront studies based on holographic techniques have been implemented [3]. In this research, we report the application of EUV holograms specifically designed for patterning.

Computer generated holograms (CGH) were fabricated on 100nm thick silicon nitride membranes with a 100nm thick Cr absorber layer. Reconstructed images at 13nm wavelength have been recorded in a 80nm thick PMMA photoresist using the EUV beamline at the Synchrotron Radiation Center (Fig. 1). The patterned PMMA were characterized by optical (Fig. 2) and atomic force microscopy, yielding excellent agreement with simulation results from the CNTech ToolSet program. A holographic technique eliminates the need for complex EUV reflective masks and optics, and is thus particularly appealing for research and development.

Figure 1: Experimental Setup used for EUV-HL.

Figure 2: Reconstructed holographic image recorded on PMMA resist. An optical microscopy image is shown with scale bar indicating 15 um.

References: