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Optical metrology of sub-wavelength critical dimensions of lines on Si wafers B.M. BARNES, R. ATTOTA, T.A. GERMER, JAY JUN, E. MARX, H. PATRICK, M.T. STOCKER, R.M. SILVER, NIST, Gaithersburg, MD — As semiconductor manufacturing progresses toward the 65 nm technology node, non-destructive characterization is required for the repeatable fabrication of devices. Optical metrology offers an advantageous solution in both cost and throughput, as the use of visible or uv light is less expensive to implement than scanning probe techniques and will offer greater flexibility as a parallel measurement process. The major impediment to using optics in the critical dimension (CD) metrology of features within the sub- wavelength regime is often thought to be the diffraction limit. However, comparisons of data to theoretical modeling can yield quantitative linewidth values. Simulations indicate that sensitivity to changes in CD below 20 nm is accessible by using structured illumination, for example reducing the illumination numerical aperture (INA). To increase the rigor of this analysis, we have imaged single, isolated lines of Si on Si with λ=546 nm light with an INA=0.11. Although the lines measured in this case range in width nominally from 200 nm to 950 nm, the engineered illumination demonstrated here is directly applicable to the extensibility of optical metrology to technologically relevant dimensions. We also demonstrate that CD sensitivity can be enhanced further by collecting images as a function of focus position, mining additional linewidth information contained in the three-dimensional interference field above the sample.

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