EXTREME ULTRAVIOLET LITHOGRAPHY

1. Title:	Chemical Force Microscopy for Imaging Chemical Distributions in Undeveloped Resists
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3. Abstract body:

Controlling line width roughness (LWR) is a critical problem in the development of EUV resists. Contributing to the difficulty of reducing LWR is the limited knowledge of the nanoscale morphology of the resist film throughout the process. Generally, the developed features are the sole characterization metric for the performance of a photoresist. However, the initial chemical structure of the resist, the distribution of photoacid after exposure, and the distribution of deprotected polymer after post-exposure bake play an important role in determining the LWR. We have applied chemical force microscopy (CFM), a variant of atomic force microscopy (AFM) that uses a chemically functionalized tip, to image chemical heterogeneities on the nanoscale in photoresist materials. CFM has been able to identify phase segregation of photoacid generator (PAG) from tert-butyl acrylate in a model resist system. For example at 10% PAG loading, large chemical heterogeneities associated with topographic features in the film as well as small heterogeneities with no corresponding topographic signature are observed, illustrating the improved resolution for heterogeneities using CFM in comparison to traditional AFM. CFM is also applied to mapping the latent image in PMMA films exposed to EUV interference patterns. The amplitude of the chemical signal is dose dependent.