Is EUV Resist Ready for the 32nm Half-Pitch Node? Status and Challenges

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The International Technology Roadmap for Semiconductors (ITRS) insertion point of extreme ultraviolet (EUV) lithography is at the 32nm half-pitch node, and significant worldwide effort is working toward this goal. Potential roadblocks, such as readiness of EUV photo-resist, have been identified and are being addressed. According to the ITRS, a production-worthy EUV resist at 32nm half-pitch has to have a photo-speed of ~5mJ/cm2 and line-edge roughness (LER) of 1.4nm.

The International Venture for Nanolithography (INVENT) alliance activity (AMD, Albany NanoTech, IBM, Micron, and Qimonda) at Albany has evaluated a broad range of EUV photoresists on various EUV exposure tools worldwide, including EUV MET at Berkeley National Lab, EUV MET at SEMATECH North (Albany, New York), and EUV interferometer at PSI.

This presentation will provide a survey of the following results:

1. Outgassing tests and how to create a test protocol and specification
2. Performance comparison of state-of-the-art chemical amplified (CA) resists at 50nm half-pitch and below
3. Power spectrum analysis of the LER and intrinsic contribution from CA resists
4. Resist responses to different aerial images

Currently, CA resist is preferred for EUV lithography. Due to possible power limitations of the EUV power source, the high photosensitivity makes CA resists extremely attractive. However, CA resists have an intrinsic weakness due to photo-acid diffusion. To activate the de-protection process, the resist needs to bake at an elevated temperature after exposure (PEB). High temperature enhances the acid diffusion and blurs the aerial image contrast. The key lithography performance parameters of CA resist—LER, photo-speed, and resolution—are interdependent; one parameter cannot be improved without sacrificing the performance of the other parameters.

The outcome of this work provides a direct assessment of how similar resist platforms react to differences in shot-noise and secondary electron effects and provides a possible path toward higher resolution. The results also provide an overview of EUV resists in relation to the projected needs for production.