Anti-Reflective-Coatings for Resists

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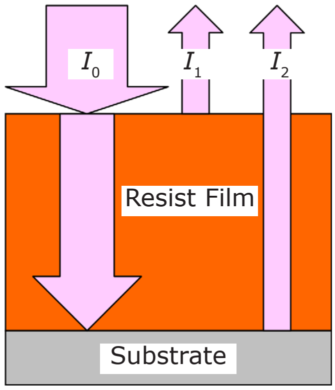
Top-Layer Anti-Reflective Coatings (TARCs)



During exposure, the incident light is reflected at the air/resist as well as the resist/substrate interface. Especially in case of thin resist films, the intensity of both rays (I_1 and I_2 in the right-hand schema) above the resist film can become equal or comparatively high. In case of constructive interference of both rays, the intensity of the reflected light is high. In case of destructive interference, the overall reflectivity is comparatively low.

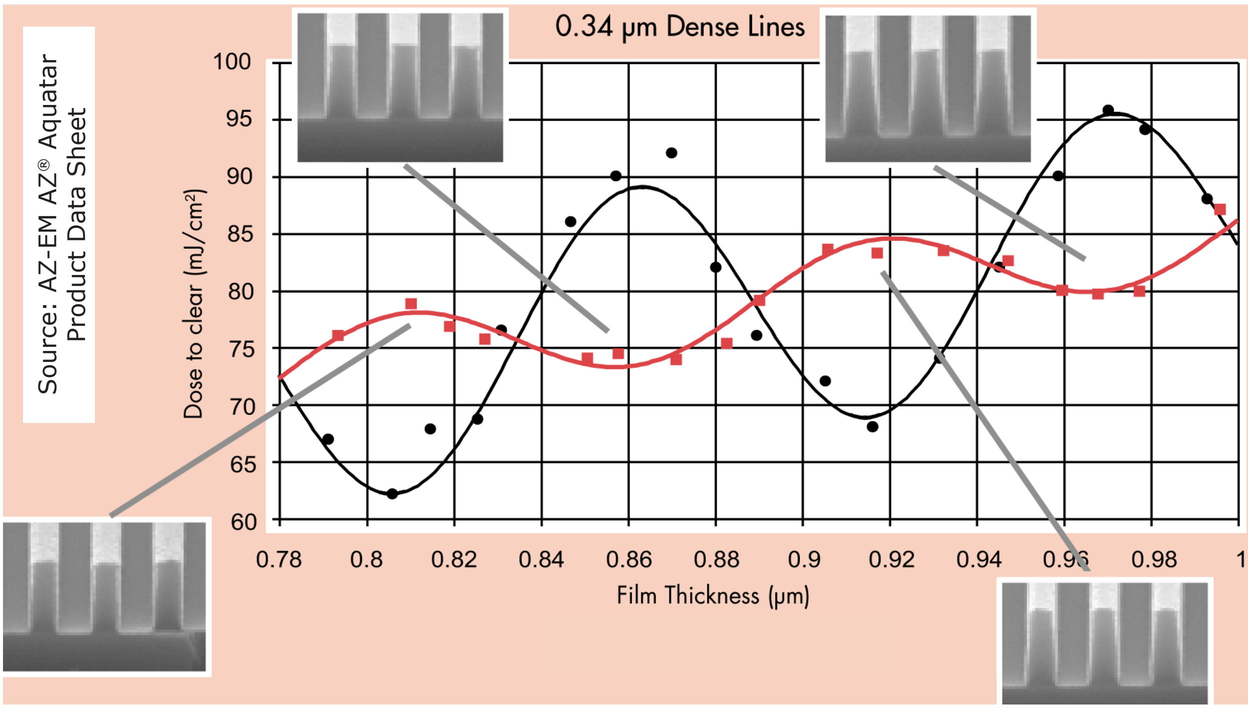
Therefore, the phase shift between I_1 and I_2 which depends on the resist film thickness is the key parameter for the effective exposure dose the resist obtains.

If the resist film thickness varies by just a quarter of a wavelength in the medium resist (in case of i-line approx. 50 nm), the amount of light absorbed in the resist film strongly differs over different locations on a wafer or between two wafers.

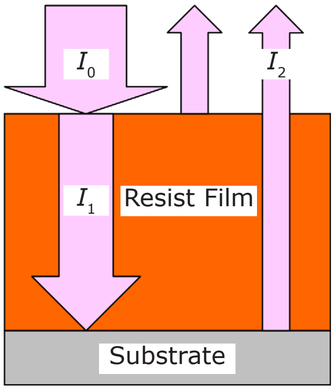
These fluctuations transfer into the applied exposure dose required for through-development (dose-to-clear). The so-called swing-curve plots this dose-to-clear as a function of the resist film thickness:

If high resolutions are required and monochromatic exposure is applied, the application of TARCs can significantly reduce the amount of light (I_1) reflected at the air/resist interface. As a consequence, I_2 has less or nothing to interfere with. Therefore, the amplitude of the swing curve becomes smaller thus improving the reproducibility of the process.

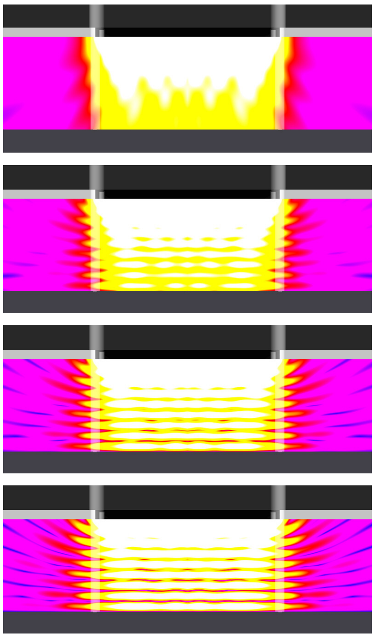
AZ® Aquatar is a TARC optimized for AZ® and TI resists. AZ® Aquatar is spin-coated onto the resist film after softbake, and is automatically removed during development due to its high water solubility. Please contact us for further technical information!



Bottom-Layer Anti-Reflective Coatings (BARCs)



During exposure, the incident ray (I_0) running towards the substrate (I_1) interferes with the ray reflected from the substrate (I_2). In case of very thin resist films, and highly-reflective substrates, the intensities of I_1 and I_2 become comparable, resulting in a $\sin^2$-function of the light intensity with a period of a half wavelength in the resist (= approx. 110 nm in case of i-line exposure).



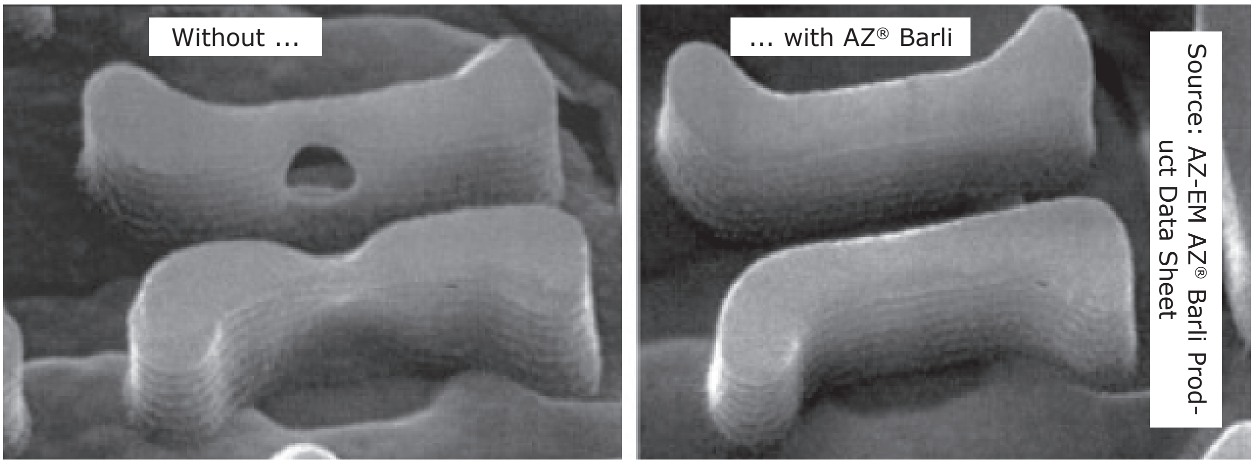
The simulated spatial distribution of the light intensity (increasing from blue to white) in the resist film as a function of the substrate reflectivity increasing from 0 (top) to 100 % (bottom).

While under broadband exposure, the $\sin^2$-pattern of g-, h-, and i-line add to a rather homogeneous light intensity pattern, a monochromatic $\sin^2$-period transfers to a similar variation of the development rate towards the substrate.

The figure left-hand shows the simulated spatial distribution of the light intensity as a function of the substrate reflectivity increasing from 0 % (top) to 100 % (bottom). The white and yellow areas develop much faster than the red, pink, and blue regions, which transfers into an undesired $\sin^2$-shaped riffles in the developed resist sidewalls.

AZ® Barli II is a BARC optimized for AZ® and TI resists under monochromatic exposure. AZ® Barli II is spincoated before resist coating, baked at approx. 200°C, and dry-etched after development.

The figure below shows the impact of AZ® Barli II on resist features: The intensity of the standing $\sin^2$-waves in the resist profile is reduced as well as certain artefacts (the 'hole' in the left image) caused by reflections. Interested? Please contact us for further technical information!



Disclaimer of Warranty

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