# Measurement of Acid-Generated Latent Image in Polymer Matrix by Fluorescence Microscopy

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Chemically amplified (CA) resists represent a major component in the semiconductor industry's ability to continue to pattern smaller features onto silicon wafers to allow for faster, more powerful devices. The chemical amplification, achieved through the catalytic deprotection of labile blocking groups attached to a polymer chain by photochemically generated acid, has afforded lithographers the ability to utilize lower intensity light sources while maintaining the high throughput required of an industrial-scale process. However, this catalytic process does have drawbacks. It relies upon the diffusion of an acid to cause deprotection of a sufficient number of acid labile groups to realize a developable change in the solubility of the polymer. This also means that the acid can diffuse out of the originally exposed area. This results in blurring of the latent image which, due to the stochastic nature of diffusion, means that the line edge becomes less uniform. The ability to analyze the deviation from the intended pattern resulting from acid diffusion alone will allow the processes of latent image formation and resist development to be deconvolved, enabling more effective design of the resist components.

Fluorescence microscopy is ideally suited for this task for three reasons: 1] acid sensitive fluorophores have been developed that can be used to indicate acid generation in resist films; 2] very few fluorophores need to be activated in order to provide an accurate representation of the acid diffusion profile; 3] fluorescence microscopes are widely available and inexpensive. While this technique has been attempted previously,[1] the fluorophore utilized required a more complicated setup and did not provide an on/off fluorescence response to acid generation. Additionally, new techniques have been developed recently that allow for sub-wavelength resolution,[2] offering the possibility that this method could be extended to view line edge roughness at resolutions approaching 10 nm. In this paper, the technique of using a new fluorescent molecule for viewing the latent image in resist will be shown along with the inversion of the fluorescence in this image, a necessary step towards single molecule resolution and LER measurements.

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[1] G. D. Feke, Q. Wu, R. D. Grober, *Appl. Phys. Lett.***1998**, *73*, 408.
[2] X. Zhuang, *Nature Photonics* **2009**, *3*, 365.

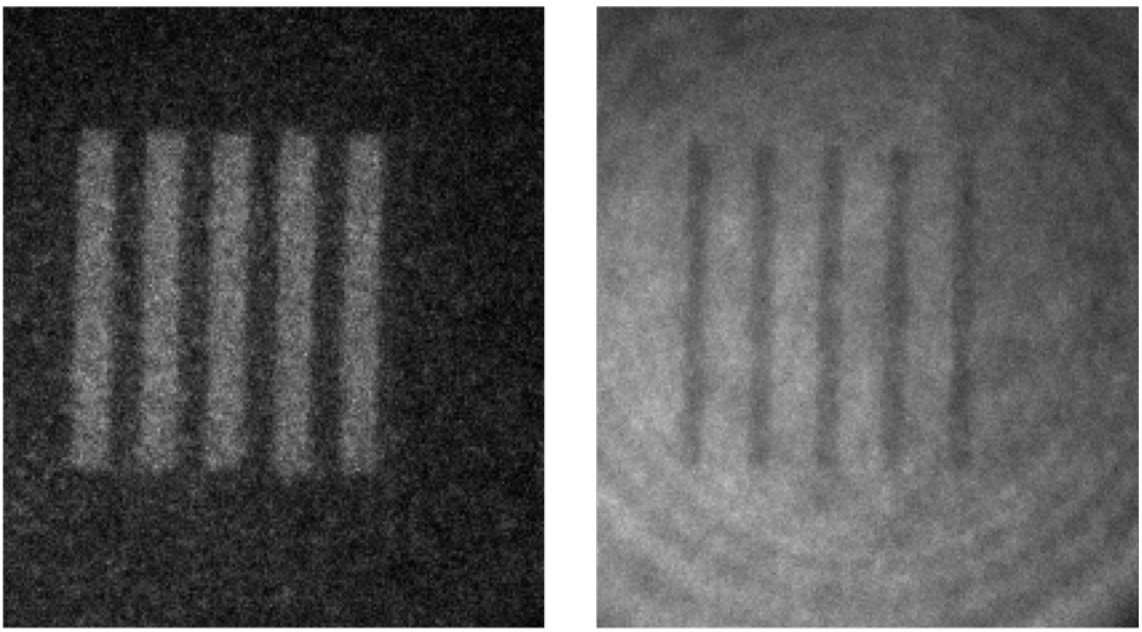
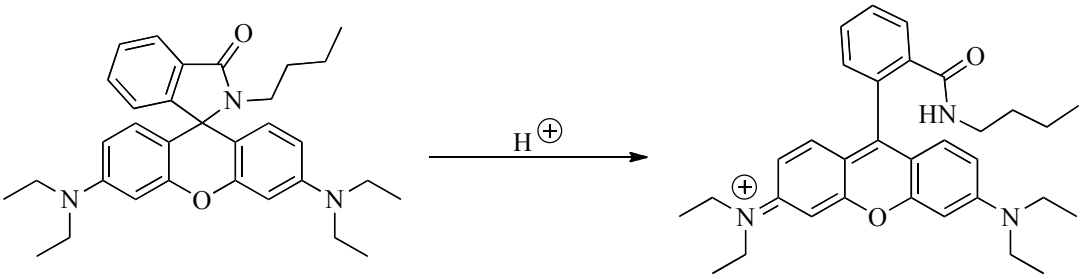


**Figure 1. Intial line/space fluorescence pattern (left) and inverted fluorescence image (right).**




Non-fluorescent Fluorescent

**Figure 2. Acid sensitive fluorescent dye.**