TECHNOLOGY

Method for Photolithographic Fabrication with Resolution Far Below the Diffraction Limit

OVERVIEW

The resolution of conventional photolithographic techniques is limited largely by diffraction limitations to be on the order of half the wavelength of the light employed. Methods such as chemical amplification can improve the resolution of photoresists to some extent, but it is still difficult to attain a resolution of better than approximately 200 nm with visible light

In optical fluorescence microscopy, extraordinary resolution has been achieved using a technique called stimulated emission depletion (STED). In STED, one laser pulse is used to excite fluorescent molecules in a small volume. A second laser pulse then causes the molecules to relax though stimulated emission before they can emit light. STED not only allows visible light to be used to achieve resolution on the order of 20 nm, but also creates a considerably more spherical excitation volume.

In principle, the application of STED to photolithography should afford similar improvements in resolution. However, the basic photophysics of conventional photoinitiator molecules is not amenable to their photodeactivation via stimulated emission. The requirement for two synchronized ultrafast lasers presents an additional challenge for the use of STED in photolithography.

Researchers at the University of Maryland have invented a new technique called Resolution Augmentation through Photo Induced Deactivation (RAPID) photolithography. In contrast to STED, in RAPID the deactivation of the photoinitiator is not accomplished by stimulated emission, but rather through another photophysical effect that is more easily controlled. Importantly, long pulsed or even continuous wave laser sources may be used for photodeactivation, circumventing the laser synchronization problem.

RAPID photolithography makes possible the fabrication of features that are far smaller than the wavelength of light, thus allowing for the creation of features of 20 nm or less with 800 nm light, a resolution that is comparable to that of the most advanced commercial lithographic fabrication facilities.

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Additional Information

INSTITUTION

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PATENT STATUS

Patent(s) pending

LICENSE STATUS

Contact OTC for licensing information

CATEGORIES

- Chemical
- Microelectronics
- Materials
- Nanotechnology + Nanoparticles + Nanomaterials

EXTERNAL RESOURCES

- US Patent 8,432,533

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