CHEMICAL AMPLIFICATION RESIST MATERIALS FOR PHOTOLITHOGRAPHY

Kwang-Duk Ahn
Division of Polymer Research, KIST

An enormous progress has been achieved in microelectronics (VLSI), especially in the technology of lithography used to generate high-resolution, high-density circuit elements. High volume production of 16 Megabit (Mb) DRAM semiconductor chips has been already made in 1994 and commercial production of 64 Mb DRAM will begin in 1995. The technology of 0.35 μm-resolution process for 64 Mb DRAM has been completed and prototype development for 1 Gigabit (Gb) chips with the technology aiming 180 nm-resolution is undergoing. The design requirements of successive generation of microchips have led to continuous reduction in microcircuit dimensions. To achieve submicron resolution the negative type photoresist materials (cyclized rubber and bisazides) were changed to the positive type photoresist materials composed of novolac resin and diazonaphthoquinone (DNQ/NR). Shorter wavelength photolithography has been introduced to pursue the limit of probable resolution capability. I-line (365 nm) lithography with the use of a DNQ/NR resist gives the sub-half micron resolution and even reaches 0.35μm resolution.

Deep-UV (DUV) lithography in the region of 250 nm wavelength is the most probable technology to obtain high resolution below 0.3 μm features. As the feature size of microchips moves into the sub-half micron regime requiring new advanced lithographic technologies, resist materials are required to have such properties as high resolution and sensitivity with improved etch resistance. The most promising resist materials to get very high sensitivity in the DUV region have been developed during the last decade based on the chemical amplification conept. The chemical amplification resists involve acid-catalyzed chain reaction mechanism and can achieve high sensitivity of 10-40 mJ/cm^2. The DUV microlithography with chemically amplified resists is expected to be a useful technology for sub-quarter micron (< 0.25 μm) resolution and production of Gb DRAMS.