High Sensitivity Chemically Amplified Resist for EUV Lithography

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Extreme ultraviolet lithography (EUVL) is now planned to address the 32 nn node. The top three issues of EUVL resist are sensitivity, LER, and outgassing. It is required that sensitivity of less than 2 mJ/cm^2, line edge roughness of less than 3 nm (3σ), and total pressure of outgassing less than 10^{-6} Pa. Especially, to achieve high sensitivity and small LER the acid generation yield have to be increased. As the results of studying chemical behaviors of many kinds of PAGs such as sulfonium salts and iodonium salts, we succeed to obtain the PAG chemical structure which goes along way toward the sensitivity under EUV exposure. Exposure was carried out at BL3 beamine in NewSUBARU. The resist evaluation system can simulate six-mirror imaging optics. Furthermore, to measure the photodissociation species under EUV exposure, the high sensitive quadrupole mass (Q-mass) spectrometer was connected to the resist evaluation system. FT-IR was utilized to measure chemical structure changing under EUV exposure. Table 1 shows the sensitivity of Resist A and B under EUV, KrF. and EB exposure. The anions of PAG of resists A and B are cyclo(1,3-perfluoropropanedisulfone) imidate and nonaflate, respectively. The cation of PAG is same. The sensitivity of resist A and B under KrF exposure and EB exposure have no change. However, resist A is about four times higher under EUV exposure. Both the results of mass spectroscopy and those of FT-IR indicate that more than two acid is generated by one photon under EUV irradiation in Resist A. The internal reaction of PAG is very effective to obtain the high yield of acid generation reactions.

Table 1. Sensitivity of resists A, B under EUV, KrF, and EB exposures.

	Resist A	Resist B
EUV exposure	1.1 mJ/cm^2	3.8 mJ/cm^2
KrF exposure	14.5 mJ/cm^2	14.0 mJ/cm^2
EB exposure	14.3 μC/cm^2	14.6 μC/cm^2