Improvement of water wettability by novel Si contained resist for 193 nm Immersion lithography

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Immersion exposure system[1)] is excellent for improvement of critical resolution in projection optical lithography system. To improve thruput of the system, trackability of the water droplet against fast movement of resist coated substrate is one of the key issues (Fig.1). To enhance water repellency is one of the effective approach and F contained resin was examined[2)], however there exist some problems such as dissolving the PAG (Photo Acid Generator) of the resin into water or resistance degradation for dry etching.

In this study, we newly proposed novel Si contained resin for ArF immersion lithography. The resin is synoecized Si additive into conventional acrylic-based ArF resist, having a lactone skeleton (featuring an adamantyl group as a protective group) at concentrations of 0–20 wt. % relative to the polymer.

We applied this resist onto an Si substrate by spin coating and baked it at 100 °C for 60 seconds. The contact angles for water droplet and TMAH developer were evaluated. Figure 2 shows the results. As the Si additive concentration increases, the contact angles for water droplet increases up to 90°. The Si concentration in the resist is evaluated by GCIB-TOFSIMS (Time-of-Flight Secondary Ion Mass Spectrometry with Gas Cluster Ion Beam). The results show the Si contains are segregated on the resist surface, which caused degradation of surface energy of the resist.

The resist development characteristics are evaluated in experimentally and resist profiles will be discussed on computational lithography.

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Reference:

1) H. Kawata, et al., Microelectronic Eng., 9,31 (1989).
2) M. Irie, K. Endo, T. Iwai, J. Photoplym. Sci. Techol., 19, 566 (2006).

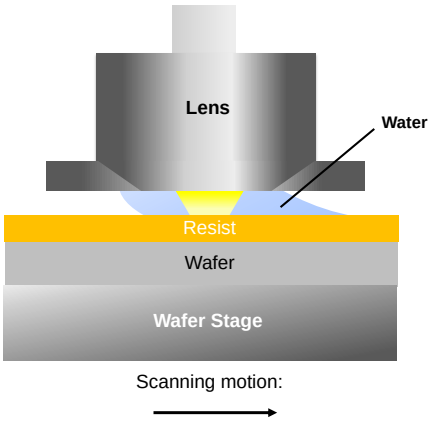

Fig.1 Schematics of the immersion lithography

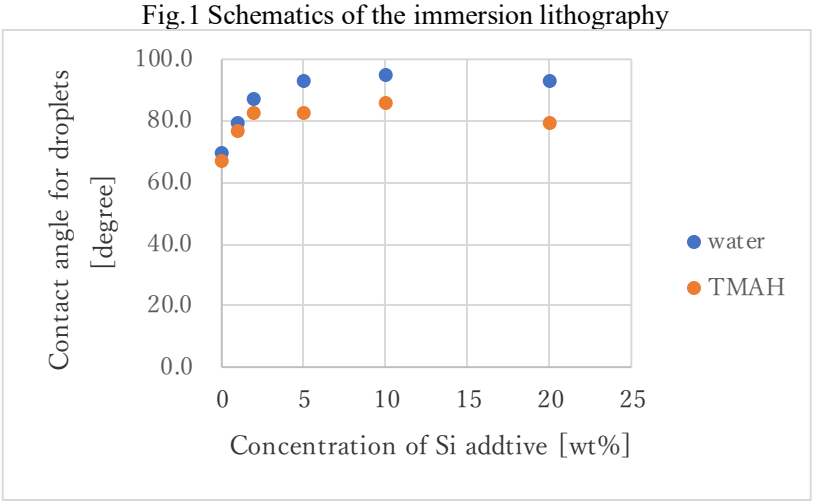

Figure 2. Comparison of development characteristics

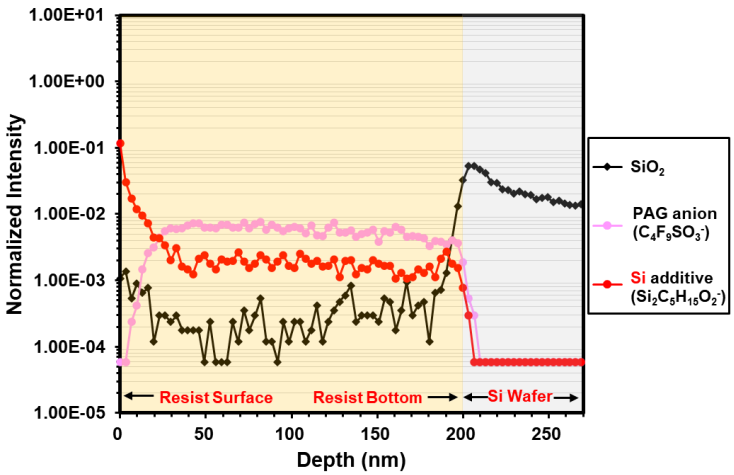

Figure 3. Depth profiles of the contains in the resist measured by GCIB-TOFSIMS (Gas Cluster Ion Beam Time-of-Flight Secondary Ion Mass Spectrometry). The Si additive is segregated on the resist surface.