Process optimization of electron beam lithography using high resolution resist TEBN-1

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Recently, ultrafine pattern is studied in the field of hard disk drive in order to improve their recording density. The development speed is very rapid as if it foreruns the road map of nanofabrication of the semiconductor industry. As one of the methods for this nanofabrication, Nanoimprint Lithography (NIL) has gotten a lot of attention recently. However, there are important issues to manufacture the NIL mold which has nano pattern of 10 nm or less, because the pattern is formed at 1:1 transcripts in this technology.

We have already reported a high resolution negative resist for electron beam, 'TEBN-1' (Tokuyama Corporation), which consists of chloromethyl calix[4] arene compounds.[1,2] We consider the TEBN-1 is applicable to the NIL mold for the hard disk media. It can form the line pattern of 8 nm wide (Fig.1) and 25 nm full pitch dot patterns, and it has high dry etching resistance. The sensitivity will be a key issue for this application. So, the higher sensitivity should be needed for TEBN-1.

In this study, we evaluate the correlation between the development condition and sensitivity in consideration of the polymerization mechanism of TEBN-1. The Si wafer coated TEBN-1 (Film thickness is about 30nm) was prepared, and then exposed to electron beam. We examined the sensitivity dependence using various developers which have different polarity. Finally we succeeded in increasing sensitivity about ten times as conventional developers such as IPA (Isopropyl alcohol) as shown in Fig. 2, by using a newly designed developer (Developer A).

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1) M. Ishida et al., Jpn. J. Appl. Phys., Vol. 42 (2003) Pt. 1, No.6B 3913

2) M. Narihiro et al., Jpn. J. Appl. Phys., Vol. 44, No. 7B (2005) 5581

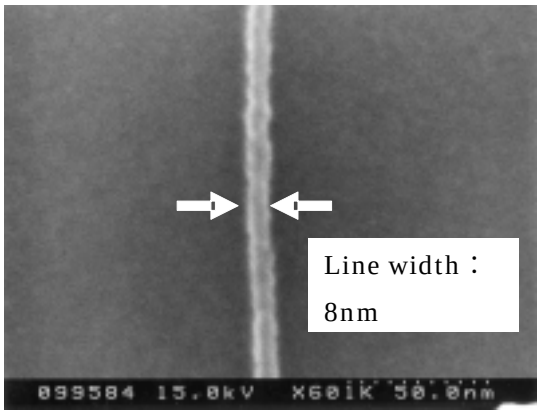

Fig. 1 SEM image of isolated line with Xylene development.

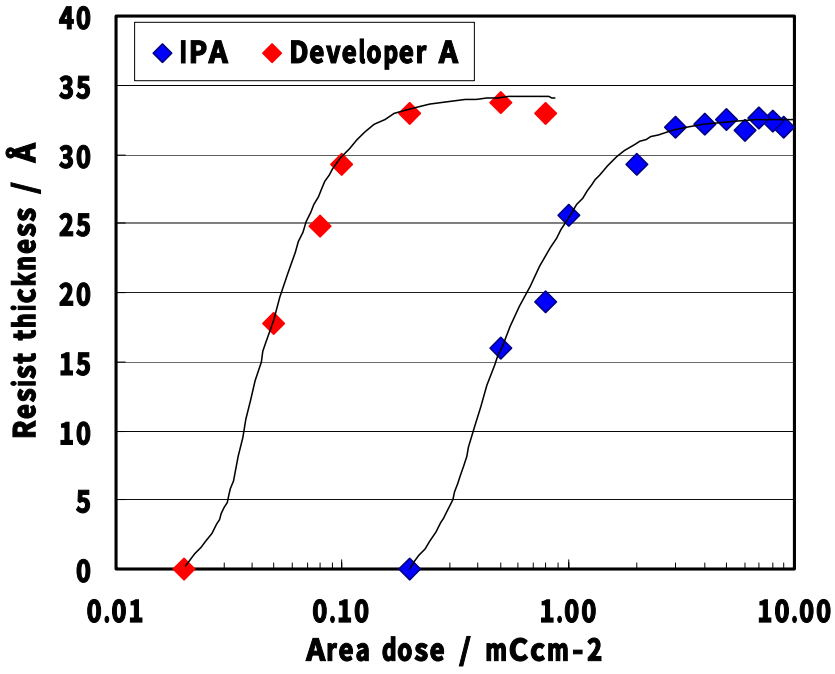

Fig. 2 Sensitivity curves of TEBN-1 developed using Developer A for 30s. The initial resist thickness was 34nm.