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Mechanisms of Topographic Development on Ni Surface by Reactive Ion Beam Sputtering

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In the sputtering process, the chemical reaction of the incident ion with the constituent atom causes some troublesome problems in sputter depth profiling by development of surface topography. In the last decade, considerable attentions have been given to the surface topographic development during sputtering, since it has been observed that the surface topography which develops during sputter depth profiling plays a very important role in broadening of depth resolutions. However, the detailed understanding of the surface roughening due to ion bombardment is still incomplete, even though the surface roughening problem could be minimized by rotating the specimen during sputtering. Recently it has been pointed out that the surface inhomogeneity is one of the main parameters for the evolution of surface microstructures[1].

It has been reported that the SIMS depth resolution of the polycrystalline Cr/Ni multilayer(NIST SRM 2135) by oxygen ion sputtering is very sensitive to the angle of incidence as a result of topographic development[2]. Especially, the ripple-type topography developed at 20° incidence angle, is mainly developed at Ni layer rather than Cr layer.

In this study, the mechanism on the topographic development on Ni surface has been systematically studied. A great topography was developed on Ni surface at the incidence angle of 20° rather than 0°. It has well-defined facet-type topographies as shown in Figure 1. One face of the facet is perpendicular to the direction of the incident ion beam so that the local sputtering yield is minimized and the other face is nearly grazing with the ion beam direction. The change in surface chemical state can be a clue to understand the mechanism of the topographic development. The partially oxidized Ni surface will be composed of two

components, metal and oxide. Initially grown small oxide islands will be agglomerated to minimize the surface energy. The oxide islands with reasonable size will be fixed at a position and act as a seed for the topography development. The metallic Ni is preferentially sputtered than oxide island because the sputtering yield of nickel oxide is 5 times smaller than that of Ni metal[3]. This results in the formation of facet-type topography.

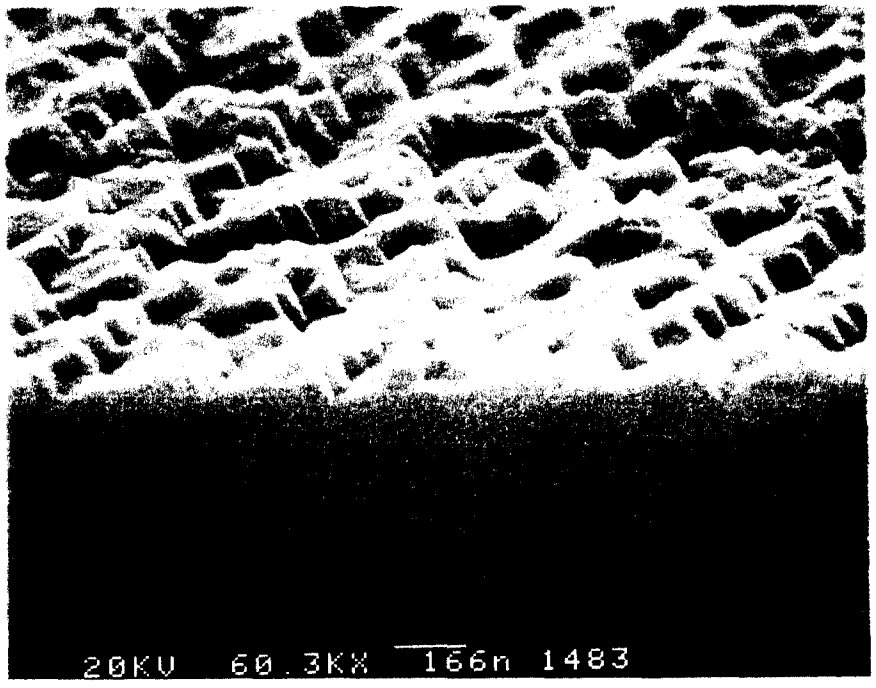

Figure 1. SEM image of the facet formed on Ni surface by sputtareing of 7 keV O_2^+ ion beam of 20° incidence angle.

(1) D. W. Moon and K. J. Kim, *J. Vac. Sci. Technol.* **A14**, 2744(1996)
(2) K. J. Kim and D. W. Moon, *Appl. Phys. Lett.* **60**, 1178(1992)
(3) G. P. Chen, J. von Seggern, H. Gnaser and W. O. Hofer, *Appl. Phys.* **A49**, 711(1989).