Nano-scale fabrication of glass by use of Ar ion beam

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The optical material, which has nano-scale 3D structure on its surface, is one of promising components in various industrial fields. In other to develop a technique to fabricate a nano-scale 3D-structure on glass materials, we tried to control fabrications through sputtering and lithography processes by changing an irradiation condition of Ar ions.

Ar^{4+} ion beams, prepared by a facility built at Kochi University of Technology [1], were irradiated onto spin-on-glass (SOG) through a stencil mask. The irradiation of Ar ions were performed with changing acceleration energy over the ranges 80 ~ 400 keV at the fluence of 80 and 800 $\mu C/cm^2$. The irradiated SOG was etched by a solution of HF. The surface profile of irradiated samples was observed by use of an alpha step IQ surface profiler before and after the etching process.

The hollow structure, whose size is consistent with that of the stencil mask, was observed. At a lower fluence (80 $\mu C/cm^2$), a lithography process is superior to a sputtering process. To the contrary, a sputtering process is superior to a lithography process at a higher fluence (800 $\mu C/cm^2$). As an example of the present results, the energy dependence of the sputtering process observed at a higher fluence is shown in Figure 1.

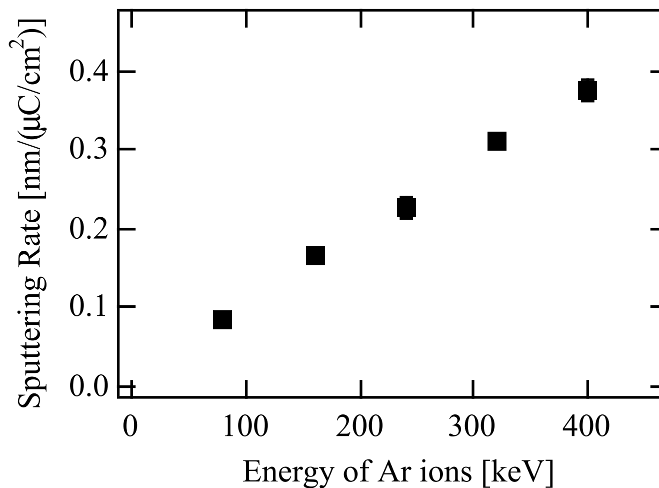

Figure 1

It is obviously seen in the figure that the sputtering rate increases with energy of Ar ions proportionally.

[1] S. Momota et al., Rev. Sci. Instrum. 75, 1497 (2004).