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Crystal Orientation Changes of Silver Films due to the Tribological Performance

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Introduction

The crystal orientation of Ag thin films on a Si(111) $\sqrt{3}\times\sqrt{3}$ -Ag surface has been studied using grazing incidence X-ray diffraction with synchrotron radiation. After preparation of Si(111) $\sqrt{3}\times\sqrt{3}$ -Ag surface, 5 nm-thick Ag was deposited on the Si(111) $\sqrt{3}\times\sqrt{3}$ -Ag at the substrate temperature of 303K in an ultra-high vacuum chamber. For the crystal orientation of the Ag film, we found the Ag{111} plane was mainly grown on the surface. However, a small amount of the Ag{100} plane was also grown on the surface, as reported by our previous work [1].

In this paper, crystal orientation changes of Ag thin films due to the tribological performance has been reported using the 5-nm thick Ag films on the Si(111) $\sqrt{3}\times\sqrt{3}$ -Ag surface.

Sample preparation

The friction experiments were carried out using diamond pin-on-plate type tribometer just after the Ag deposition in the same UHV chamber. The sliding speed and normal load were 1.0 mm/s and 250 mN, respectively. Schematic illustration is shown in Fig. 1.

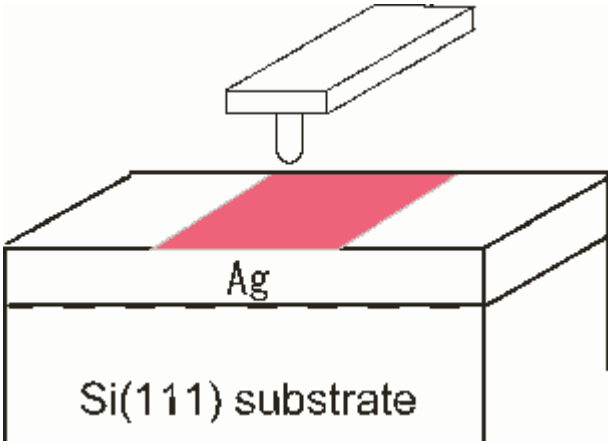

Fig. 1 Friction experiments using diamond pin.

Results and Discussion

We found a coefficient of friction of Ag films on the Si(111) $\sqrt{3}\times\sqrt{3}$ -Ag decreases from 0.07 to 0.03, as increase of reciprocal sliding cycles, as shown in Fig. 2. In synchronization with the coefficient change, the Ag{100} plane is gradually disappearing. As a result, the Ag{111} planes cover the entire surface after 50 sliding cycles, as shown in Fig. 3. Moreover, we found the domain size of Ag {111} films increases as increase of reciprocal sliding cycles by measuring the rocking curve width. These results directly show a minimum coefficient of friction of Ag films is determined by the sliding of the Ag(111) plane.

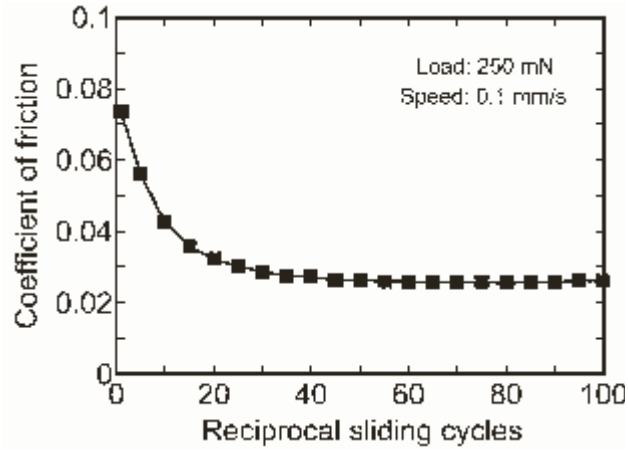

Fig. 2 Transition of coefficient of friction

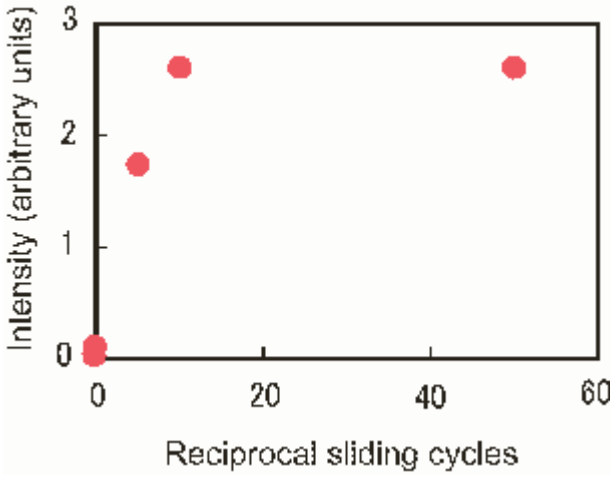

Fig. 3 Intensity of Ag 111 reflection

References

[1] K. Akimoto, M. Lijadi, S. Ito, and A. Ichimiya, Surf. Rev. Lett., 5, 719, 1998.

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