EUV in-plane diffraction characterization of quasi-periodic nanoripples produced by ion beam sputtering

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Low-energy ion beam sputtering (IBS) is a unique nanofabrication tool, which can fabricate wafer-scale self-organized nanostructures (e.g. ripples, dots, holes) with high throughput. These nanostructures have potentials in applications from nanogratings to diffusers. The long-range order is still an open issue for self-organized nanoripples, e.g., on organic surfaces.

In this contribution, based on the bilayer strategy to enhance nanoripples produced by IBS [1], we have extended the nanoripples from the photoresist/antireflection coating (ARC) bilayer to the Au/ARC bilayer. Atomic force microscopy (AFM) and extreme ultraviolet (EUV) in-plane diffraction measurements were used to characterize the quality of the nanoripples. The results obtained from AFM (Figs. 1 and 2) and EUV in-plane diffraction (Fig. 3) are consistent. Moreover, the EUV in-plane diffraction (~1×4 mm^2) collects larger area than the AFM (5×5 μm^2). In particular, the in-plane diffraction curve of the ripples on the Au/ARC bilayer even shows a peak, corresponding to the diffraction at the -1st order of a quasi-periodic diffraction grating at a wavelength of 15 nm and an incidence angle of 80° versus the surface normal.

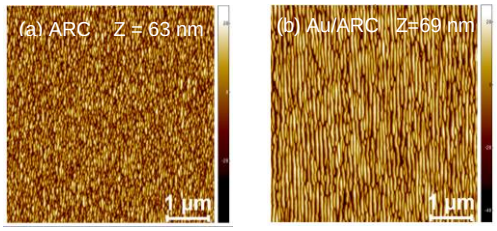

Fig. 1 Representative AFM images of the morphology on the (a) ARC, and (b) Au/ARC bilayer surfaces.

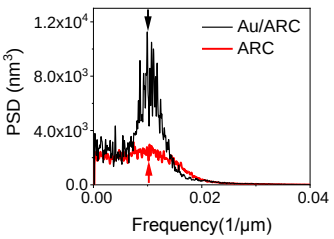

Fig. 2 PSD curves of the AFM images shown in Figs. 1(a) and 1(b). The arrows show the ripple periods for the ARC and Au/ARC cases.

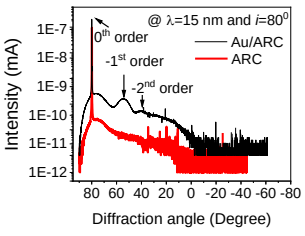

Fig. 3 Diffraction intensity angular spectrum of the ripples on the AR and Au/ARC surfaces.

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References

[1] J. Li, G. Yang, R. M. Bradley, Y. Liu, F. Frost, Y. Hong, 2021, Nanotechnology **32(38)**, 385301.