Extreme sensitivity of EUV ellipsometry to layered structures

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EUV multilayer polarizers enable us to carry EUV polarimetry and ellipsometry with a synchrotron light source as well as a laboratory light source of a Laser Produced Plasma.[1] Among the applications of polarization measurements at EUV, ellipsometry of thin film samples is of great interests since metal layers can be studied due to the semi-transparency of all materials in the EUV and also extremely high thickness sensitivity is expected due to the short wavelength. This has been demonstrated experimentally for a 40nm thick Mo layer sputter-deposited on a Si wafer.[2] This experiment revealed a new resonance-like structure in the angle of incidence response of the relative amplitude attenuation Rp/Rs=tan(psi)exp(i.delta), which is to be studied theoretically in this report.

In order to know the origin of the resonance and also to have more general idea on the thickness and optical constant sensitivity of EUV thin film ellipsometry, theoretical study has been carried out with the extinction ratio of 0.001 of a practical EUV multilayer polarizer being taken into account for the accuracy estimation of a state of polarization detection. It has been found that EUV ellipsometry has extremely high sensitivities of 0.001nm for the thickness, 0.0001 for the refractive index, and 0.00001 for the extinction ratio. The resonance structures in the complex relative amplitude Rp/Rs as a function of the thickness and also the angle of incidence are clearly seen as originating in the condition of Rs=0. It has also been found that the resonance condition can be easily tuned by a slight adjustment of the angle of incidence. Practical methods utilizing this material and optical structure sensitivity in gaining a good polarization contrast will be discussed.

References

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