AZIMUTH-DEPENDENT OPTICAL ANISOTROPY AT THE EDGES OF MICROSTRUCTURES

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The comprehensive characterization of nanometer thickness microstructures is extremely important and in urgent demands in the area of nanoscience and nanotechnology, particularly for the micro/nano devices. Tremendous optical microscopes were developed for the microstructure characterization including ellipsometric microscope, near-field ellipsometric microscope, differential confocal microscope, scanning optical interfermeter and reflectance difference microscope (RDM). [1] Among them, RDM is a simple and convenient method while possessing the advantages of high optical anisotropy sensitivity, non-destructive and rapid response. Besides, the normal incident light of RDM greatly simplifies the data analysis. [1, 2] Two reasons mainly contribute to the optical anisotropy at the edges of step microstructures. Firstly, the light scattering induced by the tilt edge of step structure, inevitably at process of manufacture, breaks the cylindrical symmetry of the normally incident light and leads to an optical anisotropy signal. Secondly, the discontinuity at the boundary of two different materials composed surface introduces a phase difference between the two halves of the light spot and gives rise to an optical anisotropy signal too. [3] In most cases, it is hard to discriminate the two reasons when the lateral length of the edge of step structure is smaller than the lateral resolution of measurement method. Therefore, ”false” anisotropy signals are probably introduced into the real signals, such as non-uniformity of the sample surface and misalignment of components of instrument setup, which demands rigid challenge for RDM instrumentation.

Here, we present a new type of azimuthal dependence reflectance anisotropy microscopy (ADRDM) based on liquid crystal retarder to meet this urgent challenge. [4] An in-situ and online calibration method was developed to eliminate the testing errors introduced by the asymmetry of the optical system. Using our proposed ADRDM, we directly and precisely image the optical anisotropy at edges of microstructures and demonstrate its polarization-dependence feature.

Keywords: Microstructures; Reflectance difference microscope; Polarization-dependence

References

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