OPTICAL METROLOGY AND NANOPHOTONICS

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Abstract

Optical metrology allows optical inspection of the geometry of nanostructures down to 10nm scale. It uses a best fit to the measured ellipsometric spectra via theoretical simulation to determine the critical dimension of an assumed shape. If done correctly, one can reconstruct images of nm resolution by using an optical instrument (with wavelength longer than 100nm). It is noninvasive and capable of probing buried structures. Reflectivity analyses of nanoscale gratings (1D to 3D) and random distribution of metallic nanoparticles on a substrate are reported. Efficient modeling softwares based on rigorous couple waves analysis (RCWA) and Green's function approach have been developed and used in optical metrology of 2D/3D gratings and isolated features on a substrate. Samples with different sizes of Gold nanoparticles immobilized on a glass substrate were investigated by variable-angle spectroscopic ellipsometry in the UV to near IR region. (SEM picture shown in figure) Both the GF method and RCWA were used to model the ellipsometric spectra. It is found that the GF method is 10 ~ 100 times more efficient than RCWA in most cases. Our model calculations show good agreement with the ellipsometric measurements. (see figure below) This demonstrates that the spectroscopic ellipsometry could be a useful tool to provide information about the size and density of nanoparticles deposited on insulating substrate. The technique can be extended to inspect buried nanostructures and biological systems.