Characterization of Thin Films at Disadvantageous Interfaces by Imaging Ellipsometry

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The characterization of thin films at disadvantageous surfaces like technical metal surfaces, curved surfaces, natural mineral surfaces, liquid surfaces or thin transparent substrates can be an issue. A number of new developments in the field of Imaging ellipsometry as well as established techniques like knife edge illumination enable new characterization methods for thin films on disadvantageous surfaces. In case of technical surfaces (Fig. 1), a pre-evaluation of the surface before the selection of the area that is represented by the measurement, increases the data quality. Ellipsometric contrast micrographs are the method of choice, because they can be recorded very fast and the contrast can be optimized to make inhomogeneities and thickness changes in the nanometer range visible. Moreover the micrographs are recorded with the same detector and the optical contrast is increased by the same optical high quality components as the following ellipsometric measurements. This circumstance helps minimizing errors caused by the mismatching between microscopic images and the measurement area.

Microscopic Müller-Matrix maps and isotropic/ anisotropic imaging enable a higher quality level in pre-evaluating of inhomogeneous surfaces and new characterization tools for surfaces that are disadvantageously regarding optical thin film metrology from the geometrical point of view.

Fig. 1. Ellipsometric contrast micrograph of an oil film on a technical metal surface.

Disturbances caused by back reflections are a main issue in thin film metrology at the interface of thin transparent substrates. Knife edge illumination is dedicated to suppress these disturbances. The technique makes use of the fact that the cut partial beam, reflected from the back of the substrate is passing the surface of the substrate with a certain distance from the blade. This area between the blade and the edge of the back-reflected beam is not disturbed by back-reflected light. With an imaging ellipsometer, where the region represented by the measurement is selected on the detector side, the thin film characterization can be performed in the area that is not hidden and disturbed by the back-reflected light (Fig. 2).

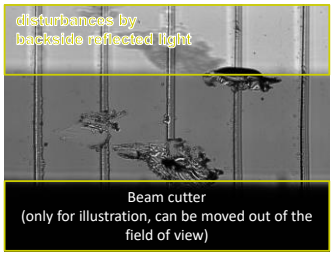

Fig. 2. Nanoparticles strips on a glass substrate. Image recorded under knife edge illumination.

The contribution will illustrate different approaches with examples from practical applications and take up new developments.

Keywords: thin transparent substrates; technical surfaces, Imaging Ellipsometry, knife edge illumination.