Calibration samples and the GUM-compliant determination of uncertainties in ellipsometry – a standardization initiative

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Ellipsometry is well known as a highly sensitive and reproducible surface analysis technique. However, in a context of metrological applications, the most important property of a measurement process is accuracy, relying on statistical precision (reproducibility) and trueness (in an absolute sense versus a given standard). The latter is much more difficult to achieve. In this presentation, we discuss the possibility of establishing ellipsometry in a diverse metrological landscape by means of defining standard procedures and best practice methodologies for the measurement and for calibration purposes. The most important task of this approach is to determine the model-inherent uncertainty, originating from parameter coupling. We achieve this by means of sensitivity analysis of the parameters resulting from the fit process. We discuss the definition of reference materials by which accuracy can be made available for ellipsometry, passed along between ellipsometry laboratories and for other measurement techniques. The determination of uncertainty is presented in this work for a number of examples involving difficult analysis models employed for samples from different production environments [1].

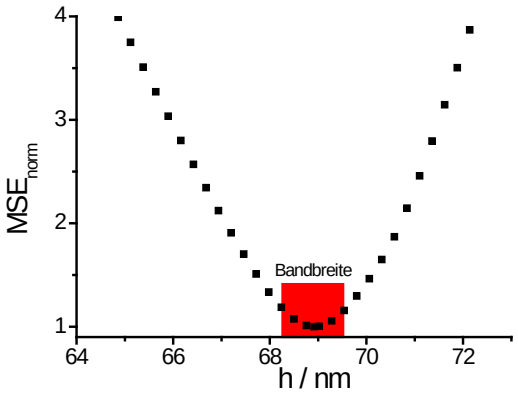

Fig. 1. Sensitivity analysis for the ellipsometric determination of a layer thickness

We present a standardization initiative with the goal to disseminate this work into an international standard alongside an inter-laboratory study comparing the results for complex samples gained by laboratories with different instrumentation. We also present the results gained within EURAMET projects focused on the metrology of materials with strong non-idealities used in photovoltaics and other energy technology.

Keywords: Ellipsometric Metrology, Reference Samples, Reference Procedures, Standardization

References

[1] D.-M. Rosu, E. Ortel, V.-D. Hodoroaba, R. Kraehnert, A. Hertwig, Ellipsometric porosimetry on pore-controlled TiO2 layers, Appl Surf Sci, 421 (2017) 487-493.