A new merit function for Mueller matrix ellipsometry and its application on subwavelength gratings

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Recently, Ossikovski and Arteaga have introduced a new decomposition technique for depolarizing Mueller matrices (MM), the so called integral decomposition technique [1]. We have refined this technique and derived a new merit function, which can be used in least-squares-fitting to achieve geometrical and/or optical properties of nominally nondepolarizing samples. We use in this new merit function the depolarizing parts of the measured MMs to weight the differences between all four non-depolarizing MMs (obtained from applying Cloude's sum decomposition [2]) and the simulated MMs. In this way, we obtain a physical reasonable weighting. Furthermore, also a criterion is gained whether the chosen geometry model is well suited for the sample under test or not.

In our contribution, we will present the application of this technique: we use it to derive the cross-section geometry of subwavelength gratings from Mueller matrix measurements in a wavelength range from 200 nm to 900 nm. The samples are made of silicon and provide linewidths as low as 25 nm. Note, that cross-sections of those samples are not accessible either with atomic force, top down scanning electron (SEM) or optical microscopy, for different reasons (tip size, charging, resolution). But to classify the new Mueller matrix based results we will compare them to those achieved with our DUV scatterometer and to cross-section SEM images (obtained at identically processed samples). Scatterometry and cross-section SEM results have been shown already to agree very well [3]. One example is given in Fig.1.

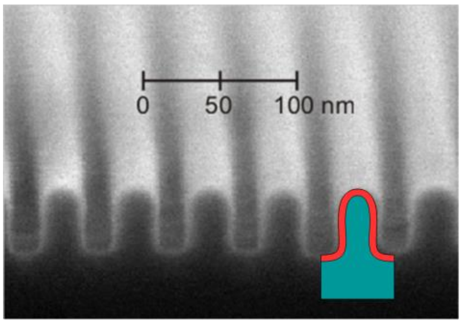

Fig. 1. Comparison of a silicon grating profile (green: silicon, red: silicon oxide) reconstructed from scatterometric measurement data with a cross-section SEM image obtained at an identically processed sample.

Keywords: subwavelength; gratings; Mueller matrix, merit function

References

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