Speeding-up imaging ellipsometry data cubes processing: a multivariate approach

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For 10 years, imaging ellipsometry (IE) has become a cornerstone analytical technique to obtain local information on the optical properties of heterogeneous and/or micro-structured surfaces. The drawback of the technique is obviously the increase of the data number and subsequently the time required to process them. Going from single wavelength IE (SWIE) to spectroscopic IE (SIE) contributes to the accuracy of the measurements and also to their flexibility. Nevertheless, it tremendously increases the complexity of the ellipsometric data inversion: two stacks of images have to be processed and reading corresponding pixels in each images leads to obtain conventional local PSI and DELTA spectra. Moreover, the optical model may change abruptly from one pixel to the other, in terms of layer thickness but also in terms of materials. Finding an appropriate starting guess for the optimization procedure of the optical model reveals therefore to be almost impossible for complex samples.

In the contribution, we propose a preprocessing of the data based on statistical classification methods of the pixels. Using a combination of k-means algorithms and hierarchical clustering coupled to back-propagation of the results, we have shown that the processing time can easily be reduced from several hours to less the 5 min for SWIE data stacks. Examples will also be given for the spectroscopic case.

Figure 1: IE data for a 50 µm square pattern of SiO2 (thickness: 100 nm) on a native oxide (silicon substrate) (A : DELTA image ; B : PSI image ; C : final thickness image for the SIO2 structure.

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