Imaging ellipsometry of thermochromic materials : optical properties at the (sub)-micron scale*

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VO_2 is a material which undergoes a reversible crystal-structural phase transition from monoclinic to tetragonal (rutile type) at 68 °C. This phase transition is accompanied by strong variations in conductivity, in magnetic as well as in optical properties. For this reason, VO_2 is known as a thermochromic material and has been proposed as a 'smart' coating for windows with variable solar gains adapting to the ambient temperature. Recently, for the first time, thermochromic films of VO_2 were successfully deposited by DC reactive magnetron sputtering on atypical stainless steel substrate [1] and their optical properties analyzed using spectroscopic ellipsometry (SE). The drawback of the technique is that the optical and structural parameters are averaged over the spot size. For smooth and homogeneous samples, this drawback has no consequence but for anisotropic or polycrystalline materials (Fig. 1) the consequences can be important, leading to averaged (and rather incorrect) optical properties. One possibility to access to the local optical properties at the (sub-)micron scale is to consider imaging ellipsometry (IE), a technique which yields images of the ellipsometric parameters (Ψ and Δ maps). Multivariate statistical strategies have been proposed to considerably reduce the time devoted to the data analysis [2].

In this paper, we used IE to show the complex evolution of the optical properties of VO_2 samples on stainless steel substrate as a function of the temperature. Ellipsometric images sequences reveal the complexity of the thermochromic transition.

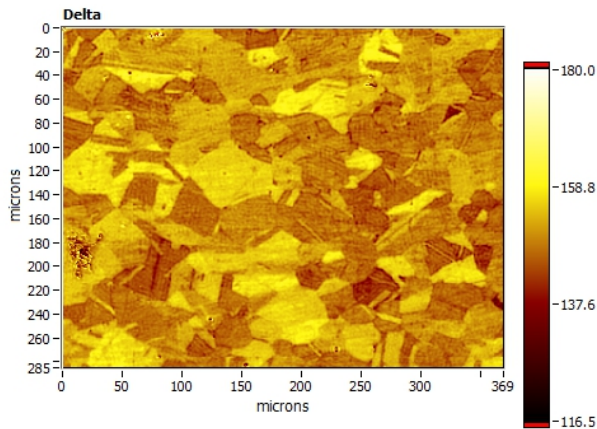

Figure 1: Imaging ellipsometry Δ map : 100nm-thick VO_2 film on stainless steel substrate (Magnif. : 10 ×)

References

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[2] C. Guyot, G. Rosolen, and M. Voué, *Imaging ellipsometry : a multivariate analysis strategy based on k-means and hierarchical clustering for fast data inversion*, BPS meeting 2012, Vrij Universiteit Brussels.

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