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Characterization of alumina-based nanoporous structures by spectroscopic ellipsometry

Nanoporous alumina membranes (NPAMs) obtained by the two-step aluminum anodization method are nowadays commonly used in nanofiltration, biosensors and drug delivery due to their well-defined nanoporous structure, but surface modification might open the areas of application [1-3]. For that reason, an optical characterization of NPAMs by spectroscopic ellipsometry technique is presented in this work.

NPAMs with similar thickness but different pore size and inter-pore distance/porosity, depending on the first step anodization conditions (electrolyte and voltage), were morphological, chemical and optically analyzed. Moreover, different alumina-based nanoporous structures (NPSs), obtained by atomic layer deposition (ALD) technique of different ceramic oxides on the NPAMs, have also been studied. Optical characterization was performed by spectroscpic ellipsometry measurements, which were carried out with a commercial apparatus (GES 5E, Semilab, energy ranging between 1.0 and 5.0 eV) at different incidence angles. Consequently, differences in basic optical parameters such as the real part of the refractive index, n, and the extinction coefficient, k, (imaginary part) depending on samples porosity and composition anisotropy could be obtained [4] and, for comparison, values at a given wavelength is also presented [5]. Transmission spectra (UV-Vis-NIR spectroscopy with wavelength ranging between 200 nm and 1000 nm)) were also recorded, and the obtained curves were compared to get information on the optical influence of ceramic oxide coverage. NPAMs and NPSs surfaces were morphological and chemically characterized by SEM images and XPS analysis, respectively, for wider and more complete characterization of the studied samples.

References

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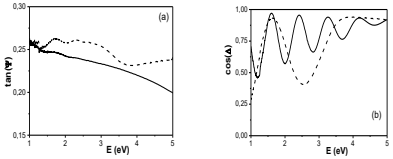

Figure 1: Changes in phase angle (a) and amplitude (b) with energy, at incident angle of 65°, for NPAMs with different average pore size: solid line, 11 nm; dashed line, 16 nm.