Optical Characterization of Nanoporous Alumina-based Structures Modified by ALD Technique

Juana Benavente

A. L. Cuevas, V. Vega, Mª. V. Martínez de Yuso, A.S. González, V. M. Prida

Dpto. Física Aplicada I. Universidad de Málaga. 29071 Málaga. Spain.

J_Benavente@uma.es

Nanoporous alumina structures (NPASs) that were obtained by the two-step anodization method present highly organized porous structure with straight pores and small pore dispersion (Fig. 1a), high surface area and transmittance. Moreover, the possibility of easy surface material and pore radii modifications by a well-established technique such as atomic layer deposition (ALD) makes these nanoporous alumina-based structures (NPA-bSs) excellent platforms for different applications (chemical/biological sensors, drug delivery, nanofilters, photonic crystals,…) [1-4].

In this work, we study structural and optical changes for a NPAS associated to its coverage by a layer of different metal oxides (Al_2O_3, SiO_2, TiO_2, Fe_2O_3 or ZnO) by ALD technique (Figure 1b) for NPA-bS samples with similar geometrical parameters (average pore radii ~ 9 nm and porosity ~ 7 %) according to SEM/TEM images analysis. Optical characterization was carried out by transmittance and spectroscopic ellipsometry measurements, while SEM, EDX and XPS analysis were performed for morphological and chemical surface changes, also using XPS depth-profile analysis for establishing the presence of coating material into the nanopore walls. Changes in samples characteristic optical parameters such as band-gap, refraction index and extinction coefficient depending on the cover layer material were determined. Moreover, the effect of samples geometry (pore size and porosity) on optical parameters was also considered.

References

[1] H. Masuda, K. Fukuda, Science *268* (1995)1466.
[2] V. Romero, V. Vega, J. García, R. Zierold, K. Nielsch, V.M Prida, B. Hernando, J. Benavente, ACS Appl. Mater. Interfaces 5 (2013) 3556.
[3] A. Santos, T. Kumeria, D. Losic, Trends Anal. Chem. 44 (2013) 25.
[4] C.S. Law, S.Y. Lim, A.D. Abell, N.H. Voelcker, A. Santos, Nanomaterials 8 (2018) 788.

Figures
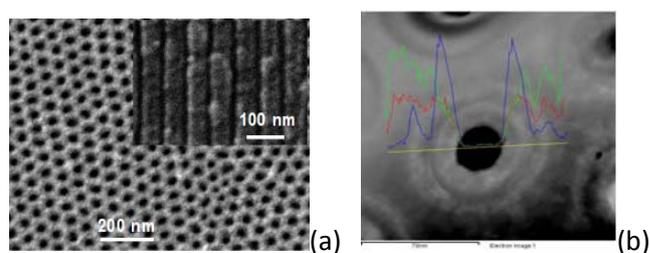
Figure 1: (a) SEM images of surface and cross-section of the NPAS. (b) TEM image of the ZnO covered sample (NPAS+ZnO): Al (green line), O (red line), Zn (blue line).