Engineering of Photonic Structures in Nanoporous Anodic Alumina

Laura. K Acosta
Josep Ferré-Borrull, and Lluis F. Marsal
Departament d'Enginyeria Electrònica, Elèctrica i Automàtica, Universitat Rovira i Virgili, Avinguda Països Catalans 26, 43007 Tarragona, Spain
lluis.marsal@urv.cat

Nanoporous anodic alumina (NAA) is a promising material formed by the electrochemical anodization of aluminum, a cost effective and fully scalable process compatible with conventional micro and nanofabrication approaches that allows the precise control over the geometry and distribution of the pores [1-2].Therefore, to engineer the nanoporous structure of NAA provides novel means of modulating its refractive index in a multidimensional fashion to fabricate advanced materials with unique optical properties to guide, reflect, transmit, emit incident light. the optical properties of NAA rely intrinsically upon its nanoporous architecture [3]. Furthermore, the pore geometry can be varied by different methods to obtain different functionalities such as funnels and structures with remarkable optical properties such as Distributed Bragg Reflectors, Rugate filters, etc. [4] Photonic structures (PS) can be obtained by NAA pore engineering. NAA-PSs are obtained by applying a sinusoidal anodization current. The application of this modulation results in a one-dimensional photonic crystal with a periodic variation of the refractive index along the pore direction and a photonic stop band.[5-6]. In this work, we present different anodization approaches to obtain photonic structures fabricated with NAA (PS-NAA) with well-resolved photonic stop bands. Figure 1a shows the sinusoidal anodization approach for the formation of photonic structures. Figure1b shows the reflection spectrum of the photonic structure fabricated by sinusoidal anodization. Figure 1c an 1d shows the top view and the cross-section of the photonic structure.

Acknowledgments

This work was supported by the Spanish Ministerio de Ciencia, Innovación y Universidades (MICINN/FEDER) RTI2018-094040-B-I00, by the Agency for Management of University and Research Grants (AGAUR) ref 2017-SGR-1527

REFERENCES

[1] A. Santos, J. Ferré-Borrull, J .Pallarès, L.F. Marsal, Physica Status Solidi (a), 208 (3), 668-674 (2011).
[2] G. Macias, J. Ferré-Borrull, J. Pallares, L.F. Marsal, Nanoscale research letters, 9 (2014) p. 315
[3] Santos, A. J. Mater. Chem. C. 2017, 5 (23), 5581−5599
[4] G. Macias, L.P. Hernández-Eguía, J. Ferré-Borrull, J. Pallares, L.F. Marsal, ACS Appl. Mater. Interfaces, 5 (2013) 8093.
[5] Laura K. Acosta, Francesc Bertó-Roselló, E. Xifre-Perez, Cheryl Suwen Law, Abel Santos, J. Ferré-Borrull. L.F. Marsal, Materials. ACS Appl. Mater. Interfaces, 12, 19778-19787 (2020).
[6] Laura K. Acosta, Francesc Bertó-Roselló, E. Xifre-Perez, Abel Santos, J. Ferre-Borrull, L.F. Marsal. ACS Appl. Mater. Interfaces, 11, (2019). 3360-3371

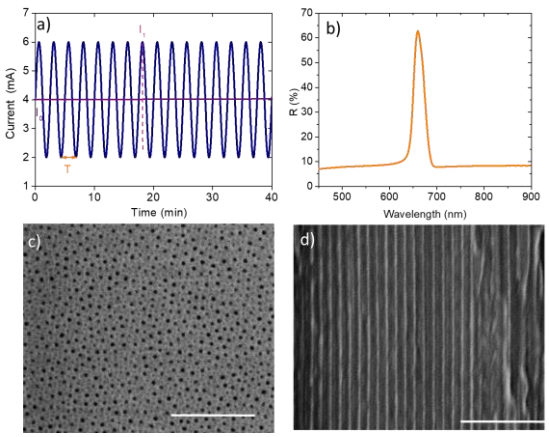

Figure 1: Photonic Structure fabricated with sinusoidal anodization profile. (a) anodization profile. (b) reflection spectrum of Photonic structure. (c) top view of NAA-PSs. (d) cross-section of NAA-PS.