Fine-tuning of the nanoporous alumina photonic stopbands by using non-conventional pulse anodization

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Photonic stopbands structures (PSB) based on nanoporous anodic alumina (NAA) are engineered by different periodic anodization of aluminum under specific conditions. The optical properties of NAA structures rely intrinsically upon its nanoporous architecture, and on the geometry and distribution of its nanopores, which can be precisely engineered during the anodization process [1, 2, 3]. Some intrinsic properties such as photoluminescence can also be modified during and after their anodization.

Here we present a novel pulse anodization approach using a gaussian current density profile to engineer NAA photonic crystals with tuneable photonic bands in the UV-Vis-NIR spectral range.

The relationship between the technological parameters and the characteristic features of the photonic stopbands were successfully assessed.

The results provide insights onto optimal anodization conditions to fabricate high-quality NAA-based photonic crystals, opening new opportunities to engineer high-quality structures for light-based technologies such optical sensing, photocatalysts for green energy generation and environmental remediation, optical encoding and lasing [4, 5, 6].

References

[1] A Santos, L Vojkuvka, M Alba, et al., Phys. Status Solidi A, 209 (2012) 2045.

[2] T Kumeria, A Santos, MM Rahman, et al., ACS Photonics, 1 (2014) 1298.

[3] L K Acosta, F Berto-Rosello, E Xifre-Perez, et al., ACS Appl. Mater. Interfaces, 11 (2019) 3360

[4] SY Lim, CS Law, M Markovic, et al., ACS Appl. Energy Mater., 2 (2019)1169

[5] MA Tabrizi, J Ferré-Borrull, LF Marsal, Scientific Reports 10 (2020) 2356.

[6] CS Law, SY Lim, L Liu, et al, Nanoscale, (2020), Accepted https://doi.org/10.1039/C9NR10526C

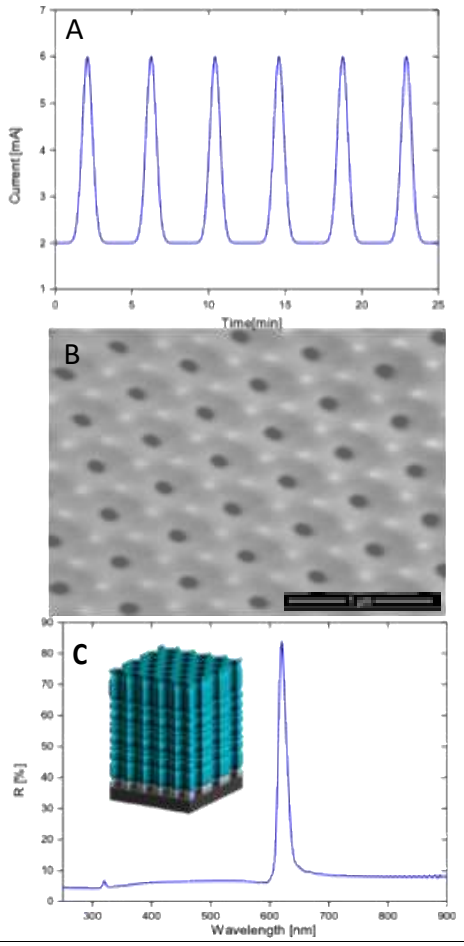

Figure 1: A. Gaussian pulse anodization current density profile. **B.** Top view ESEM image of NAA. **C.** Reflection spectrum of a gaussian NAA photonic crystal. Inset a schematic cross-section of the photonic structure.