# Tunable optical properties of nanoporous anodic alumina structures by pulse anodisation

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Structurally engineered nanoporous materials attract plenty of attention due to their potential applications in areas such as electronics, photonics, drug delivery, energy, and so on. Nanoporous anodic alumina (NAA) produced by electrochemical etching of aluminum has become a popular material as a result of its cost-competitive fabrication processes and its outstanding set of properties such as self-organised nanoporous structure, straight cylindrical nanopores of high aspect ratio, optical properties, chemical and thermal stability [1].
Recently, different anodization approaches have been proposed to create new structures and pore geometries (e.g. pore diameter, interpore distance, porosity). They allow to tune the optical properties of NAA (e.g. photoluminescence, reflectance, absorbance, emission, etc.) and propose applications in optical biosensing and photovoltaic fields [2,3,4].
Distributed Bragg reflectors (DBR) are optical structures formed by the periodic repetition of two layers in depth with different refractive index and thickness and produced in NAA by stepwise pulse anodisation approaches (Figure 1). Other interesting optical structures are named gradient-index filters (GIF) in which the effective refractive index is continuously modified in depth in a sinusoidal or pseudosinusoidal way o profile. These structures can also be obtained in NAA by applying a sinusoidal current anodization and leads to an enhanced reflection of light in narrow regions of the UV-Visible-NIR spectrum.
In this work, we present a detailed study on the structural and optical characteristics of NAA-DBR and NAA-GIF structures and how we can tune the optical signal by modulating fabrication parameters.

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## References

[1] LF Marsal, L Vojkuvka, P Formentin, et al., Optical Materials 31 (2009) 860.
[2] T Kumeria, A Santos, MM Rahman, et al., ACS Photonics, 1 (2014), 1298.
[3] A Santos, M Alba, MM Rahman, et al., Nanoscale Res Lett, 7 (2012) 228.
[4] T Kumeria, MM Rahman, A Santos, et al., ACS Appl. Mater. Interfaces, 6 (2014) 12971.

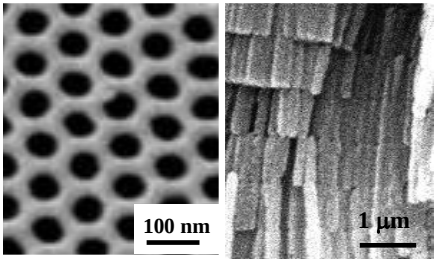


**Figure 1:** Top view (left) and transversal view (right) of a NAA structure formed by the periodic repetition of two layers with different refractive index and thickness (SEM image).