Design and Fabrication of Photonic Bands in Nanoporous Anodic Alumina-based Rugate Structures

L. Karen Acosta, Elisabet Xifre-Perez, 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

Rugate structures (RS) are one-dimensional photonic crystals with a continuous and periodic variation of its refractive index with depth. They can be obtained on the basis of nanoporous anodic alumina (NAA), formed by the electrochemical anodization of high-purity aluminum by means of a sinusoidal anodization current [1]. The sinusoidal modulation of the refractive index results in an interesting optical behavior consisting of a well-defined photonic stop band. Furthermore, several sinusoidal profiles can be overlapped in order to produce films with several forbidden phonic bands [2 ,3].

The optical properties of NAA-RS can be engineered by adjusting several design parameters such as the average anodization current, the current amplitude, the period and the number of periods of the sinusoidal current component. This way, high quality and selective photonic bands located in the ultraviolet (UV), visible and near infrared (NIR) range can be precisely defined.

In this work, we design and fabricate NAA-RS with photonic bands in the UV and VIS, a spectral range especially interesting for photonic applications like sensing and data coding. We make a systematic study of the influence of each design parameter on the optical properties of NAA-RS, emphasizing the influence of the design parameters on the quality factor and position of the photonic stop band. An example is shown in Figure 1a, where the influence of one of the design parameters (period length) on the position and width of the photonic bands of NAA-RS is observed.

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References

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Figures

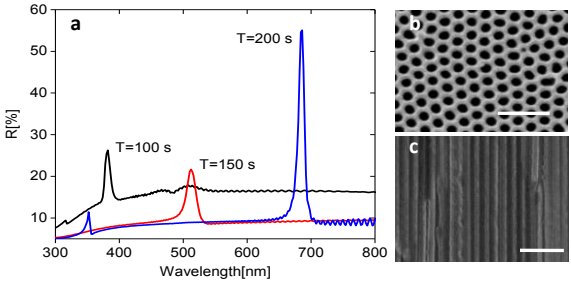

Figure 1: (a) Reflection spectra of NAA-RS with different sinusoidal period (T), and SEM images of a NAA structure: (b) top view and (c) transversal view. Scale bar: 500 nm.