Photonic engineering of nanoporous alumina: trends and applications

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Nanoporous anodic alumina (NAA) has become a popular material as a result of their outstanding set of properties and cost-competitive fabrication processes [1-2]. It can easily be prepared by anodization of aluminum in certain acidic media, and under specific conditions, their structure presents a self-ordering defined by a close-packed hexagonal array of parallel cylindrical nanopores. By controlling anodization conditions, the diameter of the nanopores can easily be varied from 10 nm up to 400 nm.
Recently, several electrochemical approaches have enabled the structural engineering of nanoporous anodic alumina. This makes possible to produce many innovative and versatile nanopore architectures by some electrochemical approaches (e.g. straight and well-defined pores, cone-like, funnel-like, modulated, serrated-like, hierarchical, three-dimensional, tip-like, etc.) [3-5]. The interaction and confinement of light inside these nanoporous structures make it possible to tune different optical properties (e.g. photoluminescence, transmittance, reflectance, absorbance, emission, etc.) at will by modifying the nanoporous structure through different fabrication parameters. This, combined with other strategies as surface chemistry functionalization, has made it possible to develop new applications in optics, electronics, energy, biosensors, molecular separation, biotechnology, template synthesis, biomedicine, drug delivery and so on [6-11].
In this presentation, we report recent advances of nanoporous anodic alumina focussing on structural engineering. We present the basic structure and properties and discuss about different electrochemical approaches to modify the nanopore morphology during or after the fabrication process. Some relevant and innovative examples and applications will be presented. Finally, future trends and challenges of nanoporous alumina are discussed.

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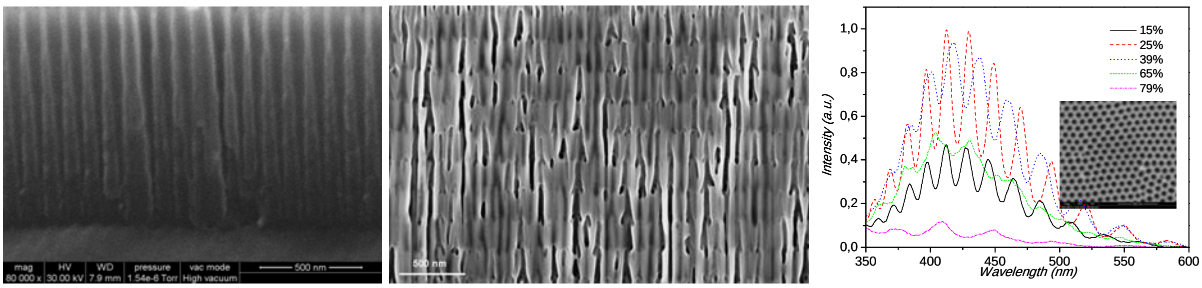

Figure. Examples of structural engineering of NAA and photoluminescent spectra for different porosities.