

Highly Ordered Hexagonal Arrays of TiO₂ Nanotubes

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Highly-ordered TiO₂ nanotubes (NTs) have gained much importance for application in hydrogen production by water splitting (photoelectrochemical cells) and the dye-sensitized solar cells (DSCs) [1,2]. The TiO₂ NTs can be synthesized using a titanium foil in fluoride containing electrolytes via electrochemical anodization method. The NTs geometry depends on different anodizing parameters (electrolyte type and concentration, pH, time, applied potential) that determine the tube features (length, pore diameter, wall thickness, etc.). TiO₂ NTs arrays were synthesized by an electrochemical anodization of a Ti foil (two-electrode cell) with an anodization potential of 60 V for 17 h, in an ethylene glycol solution containing NH₄F (0.3 wt%) and H₂O (2 wt%) at room temperature [3]. It was implemented, prior to the anodization, three different pre-treatments on the Ti foil: a chemical etching with 4% HF solution, a mechanical polishing and an electropolishing in a H₂SO₄/HF solution, with an applied potential of 10 V during 4 min. In this work, it is described the impact that a simple pre-treatment has to the template growth and final thickness after a single anodization step, as well as on the template quality (NTs organization and domain size). For this purpose, the topography of the Ti surface (prior to the anodization) with these 3 pre-treatments and an as-rolled Ti sample was investigated by Atomic Force Microscopy. Roughness studies were compared with the NTs template thickness and organization quality. Highly self-ordered arrays of TiO₂ NTs were obtained, and found that pre-treatments that decrease the Ti surface roughness are a crucial step in the TiO₂ NTs electrochemical anodization syntheses for obtaining: a fast NTs growth attaining a highest final template thickness; an enhancement in the NTs organization quality reaching highly ordered hexagonal NTs arrays in larger areas [3].

References:

- [1] B. O'Regan, M. Gratzel, *Nature*, 353, 737–740, (1991).
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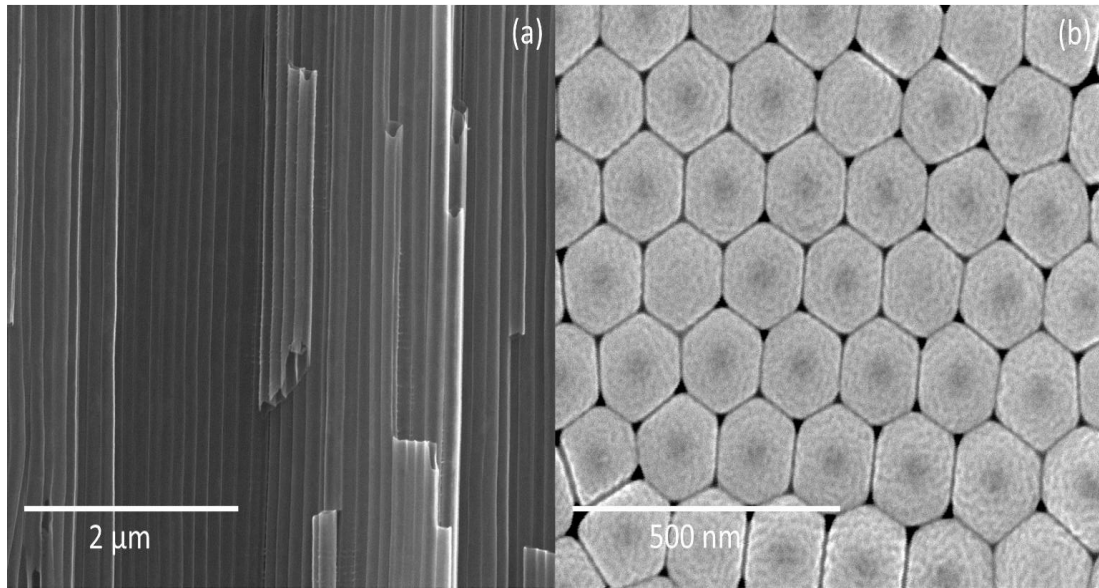


Figure 1. SEM images of TiO₂ NTs with hexagonal arrangement obtained by anodization: (a) cross- section view and (b) bottom view.