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Anodic fast-growth of highly ordered hexagonal arrays of TiO_2 nanotubes by a single anodization step

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Highly-ordered TiO_2 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 TiO_2 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.).We synthesized TiO_2 NTs arrays 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 NH_4F (0.3 wt%) and H_2O (2 wt%) at room temperature [3]. We 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 H_2SO_4/HF solution, with an applied potential of 10V during 4 min. In this work, we describe 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. We obtained highly self-ordered arrays of TiO_2 NTs, and found that pre-treatments that decrease the Ti surface roughness are a crucial step in the TiO_2 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.

References:

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