Recent Advancements in Development of Anodic TiO_2 Nanotube Layers

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Self-organized TiO_2 nanotubes arrays, formed by electrochemical anodization of Ti, have attracted tremendous scientific and technological attention, due to their remarkable properties such as the tunability of dimensions, their directionality, high surface area, low density, and ability to absorb significant amount of incident light [1,2].

The most widely used electrolyte for the synthesis of TiO_2 nanotube layers is based on ethylene glycol containing small amounts of water and fluoride ions. However, nanotubes prepared in these electrolytes present a double-walled structure, with the outer wall consisting of almost pure TiO_2 and the inner wall consisting of TiO_2 contaminated with carbon and fluoride species [3,4]. In the recent years, the selective etching of the inner nanotube wall on Ti layer enabled synthesis of single-wall nanotubes that showed a superior photo-electrochemical performance compared to their double-walled counterparts [5]. An extensive etching enabled also the synthesis of single tube powders, which could be effectively decorated with Fe_3O_4 nanoparticles to act as magnetically guidable photocatalyst [6,7].

In addition, the area that can be anodized was significantly upscaled to dozens of cm^2, and benefit of such large area TiO_2 nanotube layers have been founds in very efficient gas and liquid phase photocatalysis [8].

The presentation will review of all these advancements in the nanotube morphologies, anodizable areas as well as nanotube chemistries and their impact on applications, with focus on the photocatalytic degradation in the gas and liquid phase and several other biological and electrochemical applications. In particular, we will discuss, how the annealing temperature of single nanotubes influences their photocatalytic performance [7], how the wall thickness of the single wall nanotubes can be optimized for the best performance [9], how to tune the colof or the tubes, etc. Experimental details and photocatalytic results will be presented and discussed.

References

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