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Hydrothermal Growth: Influence of Process Parameters to Design Tio_2 Nanostructures

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Extended Abstract

Over the past several decades, numerous research activities have been focused on fabrication of titanium oxide (TiO_2) films owing to their broad applications in various fields such as medicine [1] (cancer treatment, antimicrobial), energy [2] (water splitting, photovoltaic), environment (air and water purification), gas sensors, photocatalysis, and self-cleaning [3].

Currently, various deposition methods have been employed to develop the TiO_2 including sol gel [4], solvothermal, chemical vapor deposition, thermal oxidation and hydrothermal method [5]. When specifically compared to other methods, the hydrothermal method has many advantages: (i) the required equipment and processing conditions is easier, (ii) during crystallization processes, growing crystals/crystallites tend to reject impurities present in the growth environment, (iii) by changing the hydrothermal conditions (such as titanium precursor concentration, reaction time, reaction temperature, additives, substrate orientation, and pH of growth solution), crystalline products could be easily modified with different compositions, morphologies and structures. However, slight variations in these parameters result in significant alterations of the properties of TiO_2.

Herein, we report the formation chemistry, growth mechanism of TiO_2 nanostructures in the surface of FTO substrate. The effects of key hydrothermal experimental conditions have been discussed to understand the different obtained morphologies. Indeed, XRD and Raman analysis confirmed the formation of the rutile phase of TiO_2. Morphological studies showed that we can obtain nanorods with a controlled sizes, between 0.3 and 3.2 µm of length, and the presence of seed layers on FTO allows to have a denser surface with vertical orientation of NRs of TiO_2. Finally, we demonstrated that a specific position of the substrate can lead to nanoflowers formation.

References

[1] S. Çeşmeli, "Application of Titanium Dioxide (TiO_2) Nanoparticles in Cancer Therapies," *J Drug Target.*, vol. 27, no. 7, pp 762-766, 2018.
[2] H. Eidsvåg, "TiO_2 as a Photocatalyst for Water Splitting—An Experimental and Theoretical Review," *Molecules*., vol. 26, no. 6, pp 1687, 2021.
[3] A. Rosales, "Self-cleaning of SiO_2-TiO_2 coating: Effect of sonochemical synthetic parameters on the morphological, mechanical, and photocatalytic properties of the films," *Ultrason. Sonochem.*, vol. 73, pp 105483, 2021.
[4] G. Petroffe, "Fast and reversible photo-responsive wettability on TiO_2 based hybrid surfaces," *J. Mater. Chem. A.*, vol. 3, pp 11533, 2015.
[5] M. Jithin, "Growth, mechanism and properties of TiO_2 nanorods embedded nanopillar: Evidence of lattice orientation effect," *Superlattices and Microstruct*., vol. 109, pp 145-153, 2017.