# Fabrication and Modification of Hierarchical $TiO_2$ Nano-architectures for Photocatalytic Applications

Gregory Lui, Jin-Yun Liao, Michael Fowler, Aiping Yu*

Applied Nanomaterials & Clean Energy Laboratory
Department of Chemical Engineering
University of Waterloo, 200 University Ave. West
Waterloo, ON, Canada, N2L 3G1

Since its photocatalytic properties were discovered more than four decades ago, titanium dioxide ($TiO_2$) continues to be a material of intense research for its large redox potential, high photo-corrosion resistance, chemical stability, and safe material properties.

$TiO_2$ hierarchical nanostructures are of increasing interest for applications in many fields including $H_2$ production, dye-sensitized solar cells, and photocatalysis[1]. These structures consist of hierarchical morphologies which provide multiple functions such as structural support, light-scattering properties, and high surface-area.

Liao et al reported the formation of one such material - hierarchical $TiO_2$ spheres consisting of nanoparticle-based nano-ribbons[2]. Here we present novel modifications to a hierarchical structure based on similar work in order to increase material performance in photocatalysis.

Hierarchical $TiO_2$ spheres were synthesized via a simple one-step solvothermal process using titanium ethoxide ($Ti(OCH_2CH_3)_4$) and acetic acid. The prepared Ti-complex material was then annealed to obtain anatase $TiO_2$. As shown in Fig. 1, the resulting spheres are 2-3 μm in diameter consisting of nano-ribbons of sub-30 nm thickness.

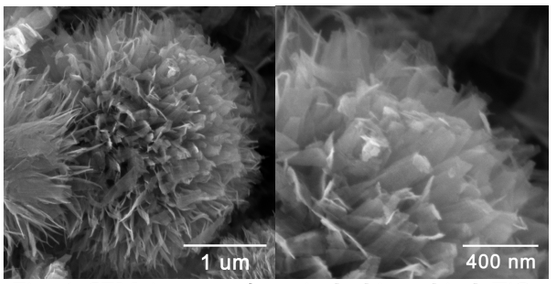


Fig. 1 SEM images of: a single hierarchical $TiO_2$ sphere (left), and a close-up image of nano-ribbon constituents (right).

Using this material basis, several modifications are applied, including: i) carbon coating of the $TiO_2$ surface, ii) use of carbon black as a conductive additive, and iii) use of stabilizers to modify material morphology.

The impact of such structural modifications will be reported and compared against the basis material with respect to the photodegradation of methylene blue.

1. Y. Li, Z. Y. Fu, and B. L. Su, *Adv. Funct. Mater.* **2012**, DOI: 10.1002/adfm.201200591.
2. J. Y. Liao, B. X. Lei, D. B. Kuang and C. Y. Su, *Energy Environ. Sci.* **4** (10), 4079 (2011).