**Atomic layer deposition of metal oxide (SnO2) on carbon nanotubes membranes for photoelectro-catalytic applications**

*Ahmed O Rashed\* A, Chi HuynhB, Raquel O RoblesB, Takeshi KondoB, Marcio LimaB, Joselito RazalA, Lingxue KongA, Ludovic F. Dumée A*

AInstitute for Frontier Materials, Deakin University, Geelong 3216, Victoria, Australia; BNano-Science and Technology Center, Lintec of America, Texas 75081, U.S.A.

\*arashed@deakin.edu.au

Introduction.

Atomic Layer Deposition (ALD) of metal oxides on different porous substrates has grabbed a great attention in various applications because it is a controllable technique that offers a precise deposition of ultrathin metal oxide films with high uniformity at self-limiting reaction [1]. As a result, the surface properties of the substrates, including pore size, adsorption and separation performance can be fine-tuned to target specific applications in energy, environment and sustainable development [2]. One of the most promising metal oxides is tin oxide (SnO2) semi-conductor, which exhibits distinctive electrical, optical, and physicochemical properties. Therefore, SnO2 has been widely used in multiple applications, such as, conducting electrodes, lithium ion batteries, and photoelectro-catalysis [3]. In this study, photoelectro-catalysis is selected as a target application while carbon nanotubes (CNT) membranes are utilized as potential substrates due to their intrinsic electrical conductivity (106 to 107 S/m), thermal and physicochemical properties. In addition, CNT membranes exhibit a high specific surface area and regular tubular structure, which can be used as an appropriate template for ALD growth of SnO2 to better understand the ALD growth mechanism of SnO2 on CNT membranes and investigate its impact on the photoelectro-catalytic activity of CNT membranes for dye-contaminated wastewater purification application.

Aims.

The study aims at the fabrication of CNT membranes, the development of metal oxide (SnO2) on the fabricated CNT membranes by ALD and the investigation of ALD mechanism of SnO2 on CNT membranes with its impact on the photoelectro-catalytic activity of CNT membranes against Methylene Blue (MB). In addition, the study targets wastewater treatment by degrading the toxic synthetic dyes.

Methods.

CNT membranes will be fabricated on Si wafer [3]. ALD deposition of SnO2 will be carried out on the fabricated CNT membrane surface using different temperatures and number of cycles [3]. SnO2 films will be analysed by ellipsometry technique. Finally, photoelectro-catalytic activity of SnO2/CNT membranes will be investigated against the pristine CNT membranes using MB photoelectro-degradation by UV light source at 365 nm with applied electric field and counter electrode while the degraded solutions of MB will be measured at 664 nm. The fabricated SnO2/CNT membranes will be benchmarked against TiO2/CNT membranes.

Expected outcomes.

This study is expected to establish a new direction for the fabrication of metal oxide/CNT membranes. In addition, the impact of ALD of SnO2 on CNT membranes will be demonstrated and the photoelectro-catalytic activity of SnO2/CNT membrane will be identified and compared with TiO2/CNT membrane towards dye-contaminated wastewater treatment.

References.

[1] J. Feng, S. Xiong, and Y. Wang, "Atomic layer deposition of hybrid metal oxides on carbon nanotube membranes for photodegradation of dyes," Composites Communications, vol. 12, pp. 39-46, 2019.

[2] N. P. Dasgupta, L. Li, and X. Sun, "Atomic Layer Deposition for Energy and Environmental Applications," Advanced Materials Interfaces, vol. 3, no. 21, 2016.

[3] S. Zhu, J. Liu, and J. Sun, "Growth of ultrathin SnO2 on carbon nanotubes by atomic layer deposition and their application in lithium ion battery anodes," Applied Surface Science, vol. 484, pp. 600-609, 2019.