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Supercapacitor with improved performance based on ALD-developed two-dimensional WO_3/TiO_2 heterojunction

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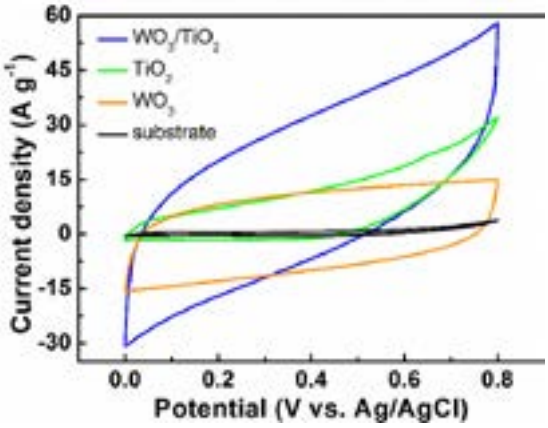
Supercapacitors (SCs) also known as, electrochemical capacitors, have been considered as one of the potential energy storage systems in addition to batteries, due to their high power density, fast charging/discharging and long-term cycling stability. Many metal oxide including RuO_2, MnO_2, Co_3O_4, NiO, SnO_2, TiO_2, WO_3, perovskites, ferrites, etc., have been applied as alternative materials for supercapacitor electrodes. Among these metal oxides, TiO_2 and WO_3 are two of the most versatile materials and have been widely applied in electronics, photocatalysts, sensors and electrochromism. In the past, we demonstrated high capabilities of monolayers of TiO_2 and WO_3 developed by atomic layer deposition (ALD). It is appeared to indicate that both of them are promising candidate materials for high-performance SC electrodes. Moreover, nanostructured WO_3/TiO_2 heterojunction was highly investigated in various applications, especially in photochemistry and photo-electrochemistry, and has already exhibited excellent electrochemical properties. However, atomically-thin two-dimensional (2D) WO_3/TiO_2 heterojunction have not yet been considered and investigated as the electrode material in SCs. Therefore, in this study, we demonstrate for the first time capabilities of the 2D WO_3/TiO_2 heterojunction developed by ALD technique for SC electrodes. CV curves of three 2D nanomaterials at scan rate of 50 mV s^{-1} are presented in figure below. The ALD-developed WO_3/TiO_2 heterojunction has a uniform thickness of ~12 nm with a relative rough surface. The SC electrode based on this heterojunction has shown excellent super-capacitive behavior with high specific capacitance up to 625.53 F g^{-1} at the current density of 1 A g^{-1} and remarkable long-term stability of 97.98 % over 2000 cycles.



Biography

Serge Zhuiykov received his PhD in Materials Science and Engineering in 1991. He has more than 25 years of combined academic and industrial experience working at different universities in Australia, Japan, Korea and Europe and industrial environments. Since 2015, he is a Senior Full Professor in Department of Applied Analytical & Physical Chemistry of Ghent University Global Campus, Korea and a Director of Environmental & Energy Research Center. His research interests include "The development, design and fabrication of new two-dimensional nanomaterials for solid-state environmental sensors and other advanced functional devices". He has published more than 200 peer-reviewed scientific publications including two monographs in 2007 and 2014, respectively. He is a recipient of the 2007, 2011, 2013 Australian Academy of Science/Japan Society for Promotion of Science and 2010 Australian Government Endeavour Executive Awards for his work on Advanced Nanomaterials.

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