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Sodium-assisted TiO_2 nanotube arrays of novel electrodes for photochemical sensing platform

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Abstract

In recent years, the study of modified-TiO2 based electrodes has gained great attention to help improve its photo-electrochemical performance. Modifications with metals, non-metals, transition metals and rare-earth metals have been studied; however, research in alkali-modified TiO2 is limited when compared to the aforementioned strategies. Owing to their low first ionization potentials, alkali metals supposed to reduce the total work function of TiO2, which can be an effective way to improve the performance of titanium-based catalysts. Herein, we investigate the design and characterization of efficient sodium-modified TiO2 photo-electrodes readily prepared by the electrochemical iodization of titanium metal followed by soaking treatment in aqueous solution containing quantitative NaOH alkaline medium. The crystalline properties revealed no change in the main peak positions and shapes of pristine TiO2 which signifies that the existence of sodium did not affect the crystalline structure of TiO2; the modification was only confined to the surface of the nanotubes. Our analysis of the photo-electric properties showed that the surface modified photo-catalysts exhibited an almost threefold increase in their photocurrent response (0.66 mA cm-2) relevant to the unmodified TiO2 (0.22 mA cm-2) under 1 sun intensity; these feature were ascribed to the former's remarkable charge separation and mobility.

These characteristics were further proved via electrochemical impedance analysis, which indicated that the surface modified catalysts exhibited less charge-transfer resistance as well as lower double layer capacitance. Thus, they maintained improved kinetics for the photo-electrochemical reaction. The surface modified samples also exhibited more negative onset potential (Eonset) relative to the unmodified sample; this was ascribed to the lesser steepness of the band bending of the treated samples which decrease the external bias needed to advance the reaction. This was further verified by our MottSchottky analysis, which demonstrates a catholic shift in the flat band potential in comparison with the pure TiO2.

Biography:

Shady Abdelnassera gained BSc from the German University in Cairo and MSc from the American University in Cairo both in Engineering and Materials Science. His current work focuses on applied research in nanotechnology especially electronic and photo-electrochemical devices.

Speaker Publications:

1."Enhanced photocatalytic performance of poly(3,4-ethylenedioxythiophene)- coated TiO 2 nanotube electrodes"; Journal of Synthetic Metals, 2019.

2."Nanostructure grapheme platinum-PEDOT electrode materials for enhanced Schottky performance and power conversion applications"; Journal of Microelectronic Engineering/ Vol-216 /2019.

3."Application of National Sanitation Foundation and Weighted Arithmetic Water Quality Indices for the Assessment of Kaani and Kpean Rivers in Nigeria"; American Journal of Water Resources, Vol -7 /2019.

4."Comparison of Selected Plant Extracts As Green Corrosion Inhibitors for Aluminum in 1.0 M HCL Solution." Journal of Applied Chemistry /Vol-12 /2019.

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