

Topical Symposium on Sustainable Surface Engineering Room Golden State Ballroom - Session TS2-ThP

Coatings and Surfaces for Renewable Energy Technology Poster Session

TS2-ThP-1 Transition Metal Oxides Efficient Electrocatalyst for Nitrate Reduction Reaction Toward Sustainable Ammonia Production, Cheng-Rui Zhuang [N56134100@gs.ncku.edu.tw], Jyh-Ming Ting, National Cheng Kung University, Taiwan

Ammonia plays an important role in modern agriculture and industry, serving as a vital raw material for fertilizers and sustaining societal development. Currently, industrial ammonia production is dominated by the Haber-Bosch process; however, this method is energy-intensive and responsible for significant carbon dioxide emissions. To address this drawback, electrocatalytic nitrate reduction reaction (NO_3RR) represents a promising sustainable way toward ammonia synthesis. Thus, the development of high-performance electrocatalysts for NO_3RR has been receiving tremendous attention recently. In this study, we have investigated transition metal oxide-based NO_3RR electrocatalyst. The electrocatalyst is synthesized using a hydrothermal process followed by thermal annealing. When operated in alkaline electrolyte, the catalyst exhibits a high faradaic efficiency of 83% and a high ammonia yield up to $0.47 \text{ mmol h}^{-1} \text{ cm}^{-2}$. With its excellent NO_3RR performance and cost-effectiveness, the synthesized catalyst is highly promising for sustainable ammonia production.

TS2-ThP-2 Comparative Electrochemical Performance of $\alpha\text{-MnO}_2$ and $\delta\text{-MnO}_2$ Coatings for High-Performance Supercapacitor Electrodes, Eduardo Estrada Movilla [eduardo.estrada.movilla@uabc.edu.mx], Álvaro Ortiz Pérez, Jhonathan Castillo Saenz, Instituto de Ingeniería, Universidad Autónoma de Baja California, Colombia

Transition-metal-oxide functional coatings have emerged as promising candidates for next-generation electrochemical energy storage systems due to their high theoretical capacitance, chemical stability, and tunable ion-transport pathways. In this work, a comparative evaluation of $\alpha\text{-MnO}_2$ and $\delta\text{-MnO}_2$ phases is reported, focusing on their performance as active electrode coatings. Four MnO_2 variants were synthesized via hydrothermal processing, yielding two α -type and two δ -type compositions with distinct structural and morphological characteristics. The coatings were deposited onto stainless-steel mesh substrates and characterized by XRD, FT-IR, and SEM, confirming phase purity and the formation of hierarchical nanostructures that directly influence electrolyte accessibility.

Electrochemical testing cyclic voltammetry, galvanostatic charge-discharge, and electrochemical impedance spectroscopy, revealed that $\delta\text{-MnO}_2$ exhibited superior behavior, achieving specific capacitances above 300 F g^{-1} at 0.1 A g^{-1} and enhanced cycling stability (>90% capacitance retention after 2000 cycles). Nyquist analysis confirmed reduced charge-transfer resistance for $\delta\text{-MnO}_2$, attributed to improved interlayer ion diffusion and increased electroactive surface area.

These findings highlight $\delta\text{-MnO}_2$ as a high-performance material for supercapacitor applications, and demonstrate its potential integration in scalable metal-mesh-based electrode architectures for energy storage systems.

Keywords: MnO_2 coatings, energy-storage electrodes, hydrothermal synthesis, supercapacitors.

Author Index

Bold page numbers indicate presenter

— C —

Castillo Saenz, Jhonathan: TS2-ThP-2, **1**

— E —

Estrada Movilla, Eduardo: TS2-ThP-2, **1**

— O —

Ortiz Pérez, Álvaro: TS2-ThP-2, **1**

— T —

Ting, Jyh-Ming: TS2-ThP-1, **1**

— Z —

Zhuang, Cheng-Rui: TS2-ThP-1, **1**