Seminar

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Institute for Plasma Research

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Title: Development of Electrocatalyst and its Implementation in Water Splitting Process

Speaker: Dr. Amit Kumar Rana

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Date: 02nd December 2023 (Saturday)

Time: 03:30 PM

Venue: Online mode

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Abstract

Creating highly efficient electrocatalysts for water splitting reactions is crucial for energy conversion purposes. This study focuses on the development of high-performance non-precious electrocatalysts for the critical process of water splitting, essential for various energy conversion applications. Specifically, we have created multi-dimensional carbon-encapsulated perovskite oxide materials using lanthanum cobalt oxide ($LaCoO_3$) as the base, which exhibit remarkable efficiency as electrocatalysts for the oxygen evolution reaction (OER). We have undertaken a systematic exploration of the impact of different carbon compounds, including acetylene black (AB), multi-walled carbon nanotubes (MWCNT), and reduced graphene oxide (rGO), on the interface modification within $LaCoO_3$. Our investigation begins with the in-situ incorporation of these multi-dimensional carbon materials (AB, MWCNT, and rGO) into $LaCoO_3$. This process results in well-defined structural and morphological features for $LaCoO_3$ and its nanocomposites, offering enhanced surface active sites for catalytic activity. Thanks to this interface engineering, the $LaCoO_3$/rGO nanocomposite demonstrates remarkable performance improvements over pristine $LaCoO_3$, $LaCoO_3$/AB, and $LaCoO_3$/MWCNT counterparts. The $LaCoO_3$/rGO nanocomposite stands out for its remarkable performance, boasting a low onset potential of 1.58 V when operating at 10 $mAcm^{-2}$. Moreover, it exhibits a minimal Tafel slope of 85 mV dec^{-1}. This enhanced OER performance is attributed to the integration of rGO sheets onto $LaCoO_3$ particles, which creates a conductive pathway and introduces electrochemically active sites crucial for catalysis, facilitating efficient charge and mass transport. Furthermore, the $LaCoO_3$/rGO nanocomposite exhibits exceptional long-term stability over 20 hours. Therefore, this work represents a significant advancement in the development of non-precious electrocatalysts with applications in clean energy technologies, showcasing the potential for future progress in this vital field.