2024「中技社科技獎學金」
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研究獎學金
Research Scholarship

Development of highly efficient electrocatalytic systems for the selective chemical synthesis based on the nickel-based chemically modified electrode

基於鎳基化學修飾電極於高效電催化化學合成系統之開發

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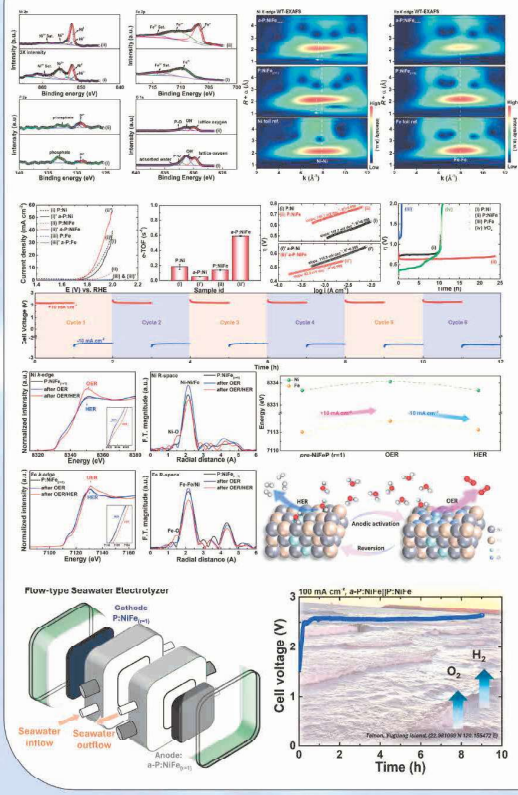
研究重點

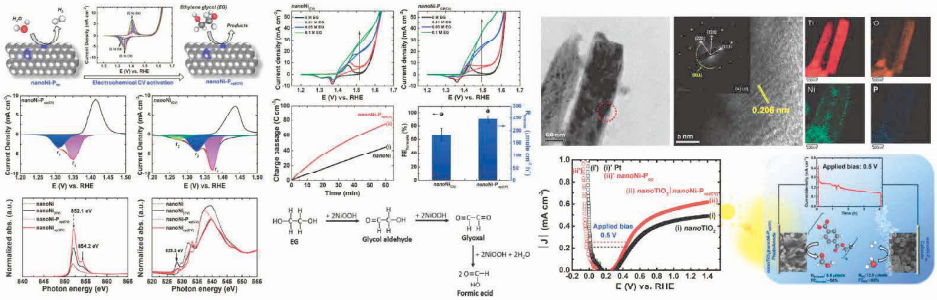
This study mainly focuses on the electrochemical preparation of phosphide incorporated nickel-based chemically modified electrodes and their electrocatalytic applications of the developed electrodes for water splitting, electrochemical reforming of organics, and organic electrosynthesis. Additionally, the critical role of phosphide species in these diverse reactions is elucidated. In the case of electrochemical water splitting, we developed a nickel-iron phosphorus modified electrode (P:NiFe) to address the challenges associated with the sluggish kinetics of oxygen evolution reaction (OER) and low stability of electrocatalysts at neutral pH. The respective roles of nickel, iron, and phosphorus in the water oxidation process and their synergistic effects were discovered, resulting in the high OER electrocatalytic activity and stability for the P:NiFe electrode at high applied current density (100 mA cm^{-2}) in pH-neutral real seawater solution. In the application of the electrochemical reforming of organics, the physiochemical properties of the electrosynthetic P:Ni, which is influential on the electrocatalytic activity, were found to be easily controlled by the electrodeposition conditions. The presence of P species was discovered to boost the electrocatalytic activity of ethylene glycol oxidation, specifically generating formate with a nearly 100% of $FE_{formate}$. In the application of organic electrosynthesis, we developed the P:NiFe electrode for the electrochemical hydrogenation of organics. For instance, the optimized P:NiFe electrode can catalyze the hydrogenation of *p*-nitrophenol to *p*-aminophenol at an applied potential of 0 V vs. RHE with a turnover frequency of 5.12 ± 0.48 h^{-1} that is about 3.0 and 7.2 times higher than nickel phosphide and iron phosphide electrodes, respectively.

研究成果

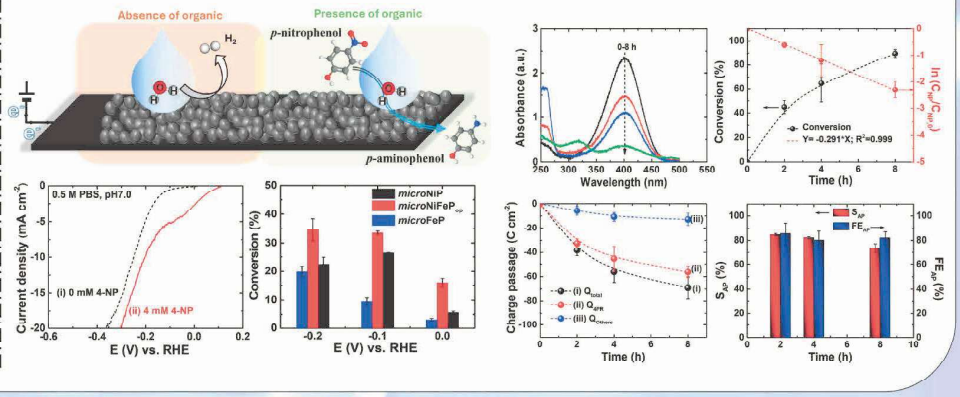
Electrochemical neutral water splitting



Electrochemical oxidation reaction beyond OER_Ethylene glycol reforming



Electrochemical reduction reaction beyond HER_*p*-nitrophenol reduction



研究生活與心得

非常榮幸獲得中技社科技獎學金，這份肯定是對我在電化學反應與觸媒開發研究上的巨大鼓舞。我一直希望能在能源轉換與綠色製程領域做出貢獻，這項獎學金不僅認可了我的努力，也賦予我更大動力。衷心感謝評審委員的肯定，還有家人、老師與同儕一路上的支持。未來我將持續努力，以實際行動推動科技進步與環境永續，回饋社會的期待。

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