UNIST | SCHOOL OF ENERGY AND CHEMICAL ENGINEERING

An Unsung Hero in Electrocatalysis

- Time: 2025.10.14. (Tue) 16:00-17:15
- Place: 104-E206 Classroom

Speaker

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Abstract

Electrocatalysis at the electrode-electrolyte interface is fundamentally governed by electron transfer across the electric double layer (EDL), highlighting a crucial mechanistic link between electrocatalytic properties and EDL structure. A central question in this field is the role of alkali metal cations at this interface, commonly known as the “cation effect”. This presentation will outline our ongoing research aimed at uncovering the fundamental principles underlying the cation effect in several important electrochemical reactions in aqueous environments.[1,2] Using advanced in situ analytical techniques,[3] we have discovered that alkali metal cations are not merely spectators, as traditionally believed, but actively influence the kinetics and mass transport in electrocatalysis. The identity and concentration of the alkali metal cation is critical in modulating electrocatalytic activity and selectivity,[4] as well as affecting electrode stability.[5] We will present a mechanism of cation-coupled electron transfer and its potentially interesting role in alkaline hydrogen evolution reactions. By gaining a deeper understanding of how alkali metal cations affect electrocatalysis, we aim to propose a novel conceptual framework for improving electrocatalytic processes.

References

1. Shin et al., On the importance of the electric double layer structure in aqueous electrocatalysis, *Nat. Commun.* 13 (2022) 174.
2. Shin et al., A unifying mechanism for cation effect modulating C1 and C2 productions from CO2 electroreduction, *Nat. Commun.* 13 (2022) 5482.
3. Bae et al., Unraveling the complex causality behind Fe-N-C degradation in fuel cells, *Nat. Catal.* 6 (2023) 1141.
4. Ji et al., Alkali metal cations: no more spectators, but homogeneous catalysts in aqueous electrolytes, *Nat. Catal.* 7 (2024) 1330.
5. Kim et al., Cation effect on the electrochemical platinum dissolution, *J. Am. Chem. Soc.* 147 (2025) 4667.