

In Situ Visualization of Ultrafast Electrocatalyst on MoS₂

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Because of the ultrathin nature of two-dimensional (2D) transition metal dichalcogenides (TMDs) catalysts, the buildup of electrolyte ions across the nanometer-scale electrochemical double layer (ECDL) may cause the formation of excitons and trions in monolayer (ML)-MoS₂ during hydrogen evolution reaction (HER), similar to those observed in gate-controlled FET devices [1]. Using the distinct carrier relaxation dynamics of excitons and trions as sensitive descriptors, an in-situ micro-cell-based ultrafast time-resolved liquid cell microscopy (TR-LCM) is setup to simultaneously probe the ultrafast carrier dynamics and electrochemical reactions at ML-MoS₂ catalyst during HER process. It is found that the whole surface of MoS₂ becomes "trion-dominant" as the potential is at HER-on state while it becomes "exciton-dominant" as the potential is at HER-off state. Through 2D mapping image on the evolution of the individual constituents of excitons and trions on ML MoS₂ surface during HER, the interplay between exciton/trion dynamics and electrocatalytic activity of ML MoS₂ affected by electrolyte gating during HER process can be unequivocally revealed. This in-situ probing technique provides an excellent platform to explore carrier behaviors at the atomic layer/liquid electrolyte interfaces during electrocatalytic reaction of 2D TMDs.

Reference:

[1] X. Liu et al. Nano Lett., 19 (2019) 8118-8124



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Research Interests

Ultrafast dynamics in materials, THz and MIR spectroscopy

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