Seminarankündigung

Dienstag, 13. Juli 2021
10:00 Uhr

ONLINE via ZOOM

"Probing the photo-catalytic CO_2 reduction on low-dimensional nano-catalysts via in situ and operando spectroscopies"

Photo-catalytic CO2 conversion to hydrocarbon fuels, which makes solar energy harvesting and CO2 reduction reaction (CO2RR) simultaneously, is a killing two birds with one stone approach to solving the energy and environmental problems. However, scientific challenges in the still low photon-to-fuel conversion efficiency of the photo-catalysts and lack of the product selectivity remain to be addressed before CO2RR could be a practical technology. In this presentation, four cases in low-dimensional nano-materials for CO2RR will be illustrated: (i) the carbon-doped SnS2 nanosheets [Nature Comm. 9, 169 (2018)] and carbon-implanted SnS2 thin films [Nano Energy 72, 104717 (2020)]; (ii) hydrogenated Ni nanocluster-modified black TiO2 w/wo KSCN-modification [Small 14, 1702928 (2018), ACS Appl. Mater. & Inter. 11, 25186 (2019)]; (iii) MoS2 few layers with defects controlled by plasma; and (iv) direct Z-scheme ZnS/ZnIn2S4 heterostructures, comprising cubic ZnS nanocrystals on hexagonal ZnIn2S4 (ZIS) nanosheets.
Vibrational spectroscopies, such as Raman and Fourier transform infrared spectroscopy (FTIR), along with various electronic spectroscopies, including X-ray absorption spectroscopy (XAS) and near ambient pressure X-ray photoelectron spectroscopy (NAPXPS), are employed to probe the light-matter-ambient interactions. For instance, in-situ dark current and Raman spectroscopy measurements are used to monitor the catalyst surface affinity toward the CO2 molecule. Whereas, diffuse-reflectance FTIR is used to explore the CO2 and related intermediate species adsorbed on the catalyst during photo-catalytic CO2RR. Moreover, XAS and NAPXPS can be used to monitor the electronic charge transfer behaviors. The role and interplay of the defects, surface modifications to the hosting materials, and their effects on the adsorption of CO2 and subsequent CO2RR, as well as the adsorbate-catalyst surface interactions during CO2RR will be discussed.

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