2SHUDQGR ,QYHVWLJDWLRQV RI (OHFWURFKHPLFDO ,QWHUID 3UHVVXUH 3KRWRHOHFWURQ 6SHFWURVFRS\

Harri Ali-Löytty
Tampere University of Technology, Finland

Solar fuels could resolve the increasing demand for energy in future if only materials solutions capable for high solar-to-fuel (STF) e ciency at cheap price are found. Solar fuels can be produced in photoelectrochemical cells (PECs) that consist of electrodes made of photoactive materials that are coated with electrocatalyst materials. Currently, the STF e ciency of PECs is largely limited by the lack of e cient electrocatalyst materials. Limiting reaction steps include the Oxygen Evolution Reaction (OER) and the CO_2 Reduction Reaction (CO_2R), which are crucial for solar hydrogen and hydrocarbon fuel production using only sunlight, water and carbon dioxide as raw materials. Operando analysis of reaction intermediates at the solid-liquid interface provides fundamental understanding of catalytic reaction mechanisms and structure-activity/selectivity relationships, which can guide the design of superior electrocatalysts. At present, X-ray Photoelectron Spectroscop (XPS) probing of the solid-liquid interface is limited to electrochemical operation at rather low current densities. Recently, “tender” X-ray Ambient Pressure XPS and a dip-and-pull electrochemical cell depicted in the Fig. 1 were utilized to study Ni–Fe electrocatalyst at di erent potentials [1]. e approach allowed operando measurements just above the onset of OER. A two-dimension model was used to describe the spatial distribution of electrochemical potential, current density and pH as a function of the position above the electrolyte meniscus and to provide guidance towards enabling the acquisition of operando XPS at high current density. e current density of 10 mA/cm? is the desired operation condition in photoelectrochemical devices. New electrochemical cell designs and early results allowing higher current densities will be presented.

Recent Publications

1. Ali-Löytty, H. et al. Ambient-Pressure XPS Study of a Ni–Fe Electrocatalyst for the Oxygen Evolution Reaction. J. Phys. Chem. C 120, 2247–2253 (2016).
2.