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Surface defect engineering in semiconducting (photo)electrocatalyst

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Surface and near surface regions play a vital role in the determining catalytic activities of photocatalysts and electrocatalysts. Firstly, catalytic reactions take place on the surface of catalysts, where the adsorption/desorption and charge transfer occur between catalyst and molecular. Secondly, abundant surface mismatches, low coordinated ions or atoms, and defects are prevalent on the surface of a materials, which can strongly alter the electronic properties of catalysts and the adsorption/desorption behaviors of molecular on catalysts. Therefore, effective control of the species, concentration, and distributions of surface defects can modulate surface electronic structure and are of great significance in promoting the catalytic activities. Here, we show several approaches of modifying the electronic structure, and molecule adsorption/desorption behavior of various semiconducting (photo)electrocatalysts through manipulating surface defects. In addition, applications of scanning probe microscopies (SPM) techniques, including scanning tunneling microscope (STM) and atomic force microscope (AFM), in revealing the effects of surface defects on these catalysts are highlighted.

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