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Exploring the Electronic and Magnetic Properties of Conventional 2D Materials and 2D MOFs: Insights from Photoelectron Emission Microscopy

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Photoelectron Emission Microscopy (PEEM) has evolved into a multifunctional technique enabling simultaneous spatial, electronic, momentum, and spin-resolved characterization of materials with lateral-scale resolution. This lecture will provide an overview of the development of PEEM, from early surface-sensitive imaging to its current state as an advanced spectromicroscopy platform. Particular emphasis will be placed on the role of synchrotron radiation as a tunable, high-brilliance light source essential for modern photoemission experiments, alongside a concise discussion of the photoemission process and its spectroscopic implications. The capabilities of PEEM will be illustrated through selected case studies on two material classes: conventional 2D systems and metal-organic frameworks (MOFs). Initial results on the semimetallic layered material NiTe2 will demonstrate momentum-resolved band structure imaging. This will be followed by investigations of epitaxial graphene and 2D MOFs. In the case of graphene, we will examine how substrate interactions and metal intercalation influence band dispersion and shift the Dirac cone features. For MOFs, we will explore the emergence of hybridized states and band formation induced by metal-ligand coordination. These studies highlight the versatility of PEEM in probing complex electronic behavior in structurally and chemically diverse 2D-materials.

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