MAESTRO: A New Beamline at the ALS for micro and nano electronic structure of *in situ* grown materials

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Based on the x-ray photoelectron effect, angle-resolved photoemission spectroscopy (ARPES) is the premier technique for the determination of the electronic bandstructure of solids, and has found wide application for many classes of materials, such as oxides, semiconductors, metals, and low-dimensional materials and surfaces. Among the most fundamental topics it addresses are the underlying many-body interactions that determine the ground and excited state functionalities of all materials.

Since these interactions are wavelength-dependent, they couple to the real-space morphologies of materials and therefore we can hope to control or enhance the functionality of materials through nanoscale engineering. A necessary first step is the development of tools which can probe electronic excitations down to the nanoscale. This need motivated the creation of the MAESTRO beamline at the Advanced Light Source, an international user facility which can conduct ARPES measurements with focussed x-rays, currently down to $\sim$ 100 nm probe size. This allows an unprecedented view of the electronic structure of intrinsically small effects such as spatial electronic fluctuations in correlated materials in bulk form, microcrystals or in engineered devices. Coupled to the beamline is a full suite of sample preparation chambers which can supply *in situ* grown oxide and 2D materials.

In this talk I will review some commissioning and scientific results from this beamline, including the examination of microscopic samples (exfoliated hetereostructures of WS_2 on BN on TiO_2) in which 3-particle charged final states (charged excitons, also known as trions), were observed [1], and islands of WS_2 grown epitaxially on graphene [2] and TiO_2 [3] by CVD techniques, in which the defect density that arises during synthesis is related to band structure, scanning tunneling microscopy, and optical properties.

References

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