NanoESCA III: Momentum Microscopy on 2D Materials

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New 2D material classes including graphene, transition metal dichalcogenides (TMDCs) or 2D heterostructures based on TMDCs or graphene are nowadays a promising candidate to be used in future electronic devices. They are chemically versatile and thus predestined to tune their electronic structure for various applications (e.g. electronic, optoelectronic and spintronic).

To examine these materials, a fast band structure mapping in combination with a high lateral resolution in real-space and live view microscopy becomes essential. The band structure mapping is used to understand the electronic structure of new material combinations, while the real-space microscopy is needed to localize the crystals on the specimen, especially if they were produced by mechanical exfoliation or intercalation techniques [1].

The NanoESCA microscope allows to easily switch between the imaging of the real- and the momentum-space of photoemission electrons and is therefore predestined to examine novel 2D materials. In the so-called momentum microscopy mode, the NanoESCA acquires the full band structure from a microscopic sample region of interest, which was beforehand defined in real-space. We will show recent band-structure measurements of several TMDCs (see e.g. [2]) acquired with the instrument and discuss the latest technical improvements of the momentum microscopy technique with respect to 2D material characterization.

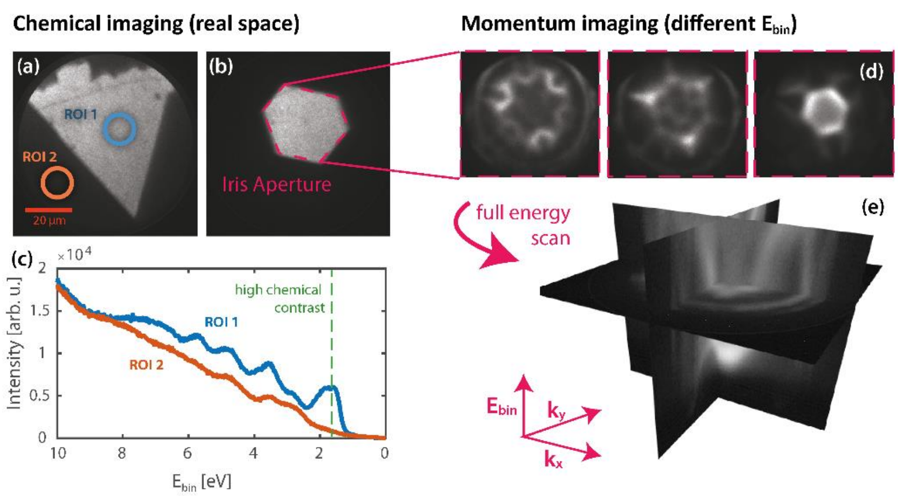

Figure 1: A WSe2 monolayer crystal (on a 5mm x 5 mm graphite substrate) was localized in real-space imaging mode (a). The NanoESCA was set to an energy with a high chemical contrast (c) between the crystal (blue) and the graphite substrate (red). The iris aperture was closed to isolate the signal coming from the crystal (b) and momentum images (d) were acquired along the valence band.

References

[1] Mattia Cattelan and Neil Fox, NanoMaterials 2018, 8, 284; doi:10.3390/nano8050284

[2] Ming-Wie Chen et al., npj 2D Materials and Applications (2018) 2:2 ; doi:10.1038/s41699-017-0047-x