X-ray spectroscopy of 2D magnetic materials at the XMCD beamline of the ALBA synchrotron: recent advances and capabilities

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BOREAS is a beamline of the Spanish synchrotron ALBA [1], devoted to the investigation of advanced materials by means of polarization-dependent soft x-ray absorption in the HECTOR end-station and scattering techniques in the MaRes endstation, in particular X-ray absorption (XAS) and magnetic circular dichroism (XMCD), soft x-ray magnetic resonant scattering, holography and coherent diffraction imaging. The XAS/XMCD HECTOR end-station is capable of attaining up to 6T on the sample with variable temperature ranging from 3K to 380K. Both end-station are fully connected with a UHV sample exchange system allowing access to MBE preparation facilities, surface characterization tools (LEED/AES), STM and an Argon-filled glovebox, making it a unique setup for both MBE preparation or clean transfer of van der Waals materials. Furthermore, ALBA synchrotron initiative in 2D and quantum materials will offer a fully integrated platform for inert-atmosphere deterministic transfer of 2D materials flakes and heterostructures-staking together with characterization capabilities and easy integration with the beamlines.
Based on some of the most recent published results [4-6], the advances of the research program of the BOREAS beamline in novel 2D materials in bulk, few layers, single layer or transferred flakes forms will be shown. The unique capabilities of the resonant X-ray absorption technique, combining extreme sensitivity with chemical selectivity, allow to investigate diverse kinds of layered materials enabling the characterization of different physical properties. Local moments and magnetic anisotropy characterization can be performed while simultaneously gaining information on the electronic structure of the investigated material. The chemical selectivity of the XMCD technique offers also the capability to disentangle complex magnetic arrangements and local moments in exchange-coupled systems[7]. Furthermore, the critical behaviour of the system near the phase transition can be mapped with sensitivity down to the single layer[2,6].

References

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