DEIMOS: 15 years at the service of magnetism, from conception to SOLEIL II

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ABSTRACT

X-ray Magnetic Circular Dichroism (XMCD) has been a cornerstone of element-specific, atomic-scale magnetism for five decades[1,2]. The DEIMOS beamline (Dichroism Experimental Installation for Magneto-Optical Spectroscopy), dedicated to soft-X-ray magnetic absorption measurements in the 350–2500 eV energy range, opened to users in March 2011 at SOLEIL synchrotron.[3] On the occasion of the XAFS jubilee in France, we propose a journey through fifteen years of instrumental evolution that have shaped DEIMOS, in permanent dialogue with the scientific challenges of its time. From 1000 K to 220 mK, and from *in situ* transport to liquid environments, the experimental phase space accessible to soft-X-rays MCD has progressively expanded. Around its two experimental stations, CroMag equipped with a superconducting magnet (7 T axial, 2 T transverse, 2 K to 370 K) and MagneTwo fitted with a fast-field electromagnet (2 T, up to 1 Hz), DEIMOS has developed a unique set of specialized sample environments in response to emerging scientific topics. The MilleK insert extends the temperature range up to 1000 K, enabling XMCD studies of high-Curie-temperature magnetic materials, such as ferromagnetic van der Waals layers of low dimensionality above room temperature. The V²TI (Versatile Variable Temperature Insert) combines variable temperature control with multiple electrical connections, enabling *in situ* transport experiments coupled to XMCD, opening the way for functional device research.[4] The microfluidic cell extends soft-X-ray MCD to liquid environments, including ferrofluids. Finally, the Dichro50 project integrated a ^{3}He-^{4}He dilution refrigerator into the CroMag cryomagnet, pushing the temperature limit to 220 mK under simultaneous X-ray irradiation and magnetic field, reaching a record-low temperature for XMCD measurements in the soft X-ray domain.[5] Looking ahead to SOLEIL II opens a new chapter for DEIMOS. While scattering or imaging techniques will naturally benefit from the improved source emittance and the higher flux density of a fourth-generation ring, the impact on X-ray absorption spectroscopy is less transformative. For DEIMOS, the source upgrade therefore represents not simply an increase in performance, but an opportunity to rethink the beamline from within. The goal is to push the principles that have defined DEIMOS from the outset: high stability, the detection of extremely low signal levels and increasingly demanding sample environments.

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