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The NFFA-APE integrated platform for growth and all-resolved synchrotron radiation spectroscopy studies on quantum materials

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Quantum materials exhibit unique physical phenomena, especially if grown in ultra-thin films or in heterostructures with other materials. We have built and operated a dedicated UHV facility where multiwavelength Pulsed Laser Deposition can synthesize quantum materials and directly deliver the atomic-layer controlled samples to an all-resolved photoemission apparatus (SP-ARPES) and to an end-station for XPS, XAS, XMCD that exploit the NFFA-APE sources on the Elettra synchrotron. Open access is granted via NFFA (www.NFFA.eu; www.Trieste.NFFa.eu). Along with users science we carry on in-house research and Ph.D. projects.
One example of relevance in quantum material science is the study of the electronic properties of anatase TiO2 thin films, e.g. the stabilization of in-gap states has been found to be correlated with the amount of Ti3+ ions by Resonant XPS and ARPES that also has provided evidence of the formation of a two-dimensional electron gas (2DEG). Both in-gap states and 2DEG are very sensitive to structural modification of thin films, such as substrate-induced strain, surface reconstruction, and thickness. Their formation and evolution were investigated down to the single-unit-cell and sub-unit-cell thickness thus indicating that no-critical thickness is required to stabilize the 2DEG at the anatase TiO2 surface and implying its purely 2D nature.

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