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Hard x-ray photoemission spectroscopy of in operando strained Vanadiumdioxide films on PMN-PT

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VO_2 films on the relaxor ferroelectric $Pb(Mg_{1/3}Nb_{2/3})_{0.72}Ti_{0.28}O_3$ (PMN-PT) provide a promising candidate for the realization of a "Mott-tronic"device. VO_2 undergoes a first-order structural phase transition at about 340 K and simultaneously switches from insulating to metallic behavior by a five orders of magnitude resistance drop. Importantly, the insulator-to-metal transition can also be driven by out-of-plane compressive lattice strain as being mediated, for example, by a PMN-PT substrate.
Here, we present a hard x-ray photoelectron spectroscopy (HAXPES) study of the electronic structure of VO_2/PMN-PT interfaces across the strain- and temperature-induced phase transition. The *in operando* monitoring of the shapes and positions of characteristic core-level emissions directly reveals strain-dependent changes of the electronic structure and phase transition temperature of the VO_2 film as well as bias-dependent changes of the electronic energy-level alignment at the VO_2/PMN-PT interface.
Overall, our results establish HAXPES as a powerful tool for the *in operando* investigation of functional oxide interfaces.

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