MBE – ARPES on High-T_c Cuprates and Nickelates

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Combining molecular beam epitaxy (MBE) and synchrotron-based angle-resolved photoemission spectroscopy (ARPES) offers unique opportunities in investigating different types of quantum materials by growing thin films with tailored properties that are not available in the bulk crystalline form. The *in situ* sample transfer, on the other hand, not only ensures cleanest surface quality but also significantly increases the efficiency of "MBE growth – ARPES characterization" feedback loop. In this talk I will present two case studies using *in situ* MBE – ARPES capability we developed at SSRL BL5-2. For the first example, one-dimensional cuprate $Ba_{2-x}Sr_xCuO_{3+\delta}$ over a wide range of hole doping were synthesized for the first time[1]. In addition to the doping evolution of the holon and spinon branches, ARPES measurements reveal a prominent holon folding branch, suggesting very strong near-neighbor attraction. Next, I will present a recent ARPES study of compressively strained $La_2PrNi_2O_7$ films grown by MBE with post ozone annealing to achieve an onset T_c of 40 K[2]. We resolved a systematic strain-driven electronic band shift with respect to that of bulk crystals, in qualitative agreement with DFT calculations, but quantitively differs by a factor of 5-10 for the strongly correlated $3d_{z^2}$ band position. These observations indicate the nontrivial interplay and importance of strong correlation and lattice dynamics in these strained films.

[1]Zhuoyu Chen, Yao Wang, S. Abadi, et al., "*Anomalously strong near-neighbor attraction in doped 1D cuprate chains*", Science 373, 1235–1239 (2021).

[2]Bai Yang Wang, Yong Zhong, Sebastien Abadi et al., "*Electronic structure of compressively strained thin film $La_2PrNi_2O_7$*", arXiv:2504.16372 (2025).