

# Studies of Atomically Perfect High-Tc Thin Films and Superlattices

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**Abstract.** Using the ‘next-generation’ molecular beam epitaxy system, we have reproducibly synthesized thin films of LaSrCuO, BiSrCaCuO and BaKBiO with rms surface roughness in the range 0.2-0.5 nm. This technology has enabled fabrication of precise and uniform multilayers and superlattices, some of which contain barriers or high-Tc superconductor (HTS) layers that are just one-unit-cell thick and yet have no pinholes over macroscopic areas [1]. In turn, such heterostructures enable novel experiments that probe into the basic physics of HTS. For example, we have established that HTS and anti-ferromagnetic order phase-separate on Ångstrom scale [2], while the pseudo-gap state apparently mixes with HTS on an anomalously large length scale (“Giant Proximity Effect”) [3].

In this talk, I will review of our most recent experiments on such films and superlattices, including XRD, AFM, angle-resolved TOF-SARS, high-resolution TEM, transport, resonant X-ray scattering and, for the first time, ultrafast photo-induced RHEED [4]. The results include atomic-layer synthesis of “artificial” (metastable) superconductors with high-Tc (above liquid nitrogen temperature), a discovery of interface HTS, and an unambiguous demonstration of strong coupling of in-plane charge excitations to out-of-plane lattice vibrations.

## REFERENCES

1. I. Bozovic *et al.*, *Phys. Rev. Lett.* **89**, 107001 (2002); P. Abbamonte *et al.*, *Science* **297**, 581 (2002).
2. I. Bozovic *et al.*, *Nature* **421**, 873 (2003).
3. I. Bozovic *et al.*, *Phys. Rev. Lett.* **93**, 157002 (2004).
4. N. Gedik *et al.*, *Science* (2007) in press.