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Atomic-Layer Engineering of Oxide Superconductors

IVAN BOZOVIC, Brookhaven National Laboratory

Using a unique molecular beam epitaxy system, we synthesize atomically smooth thin films, multilayers and superlattices that contain cuprates as well as other complex oxides, in order to enable novel experiments that probe the basic physics of HTS. We have also been trying to synthesize new artificial superconductors in form of superlattices made out of cuprates, nickelates, bismuthates, aluminates, etc. The samples are characterized in-situ by RHEED and TOF-ISARS, and ex-situ by XRD, AFM, transport measurements, high-resolution TEM, etc. In most cases we studied so far, one apparently encounters some competing instabilities (CDW or SDW formation, electron localization, etc.). The quest for hypothetic superconducting phases may lead one to search through a large portion of the compositional phase-space; to this end we have developed techniques for combinatorial synthesis and high-throughput characterization including parallel (multi-channel) measurements of resistivity, Hall Effect, and mutual inductance. Our most recent findings will be reported. *Work done in collaboration with G. Logvenov, A. Gozar, A. Bollinger and O. Pelleg (BNL), J. Clayhold (Miami Univ., OH) and S. Pennycook (ORNL).