Probing Artificial Quantum Materials Using Soft X-ray Spectroscopies

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Soft x-ray techniques such as x-ray absorption spectroscopy, angle-resolved photoemission spectroscopy (ARPES), and resonant soft x-ray scattering have played a central role in our understanding of the electronic structure of strongly interacting electronic materials that exhibit collective behavior, including the high-Tc cuprates and colossal magnetoresistive manganites. In recent years, a frontier has emerged where new electronic materials can be artificially engineered at the atomic-layer level using state-of-the-art growth techniques. These include materials that can be synthesized using oxide molecular beam epitaxy that cannot exist in bulk crystalline form or novel states that can emerge at the atomic interfaces between complex materials. I will describe ARPES and soft x-ray studies of these thin films that can shed new light onto existing problems such as high-Tc cuprates and manganites as well as probe the electronic structure artificially engineered oxide superlattices with novel interfacial properties. I will conclude by discussing the future prospects for using intermediate energy x-rays to gain further insights into the electronic structure of artificial quantum materials.

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