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Orbital Control in single unit cell LaNiO3/LaAlO3 superlattices
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Oxide heterostructures built from strongly correlated electron materials offers unique opportunity to generate new ground-states by altering the balance of competing energies in the system. In pursuit of rational control of orbital polarization, we present a combined experimental and theoretical study of single unit cell $LaNiO_3/LaAlO_3$ superlattices[1]. Polarized x-ray absorption spectra show a distinct asymmetry in the orbital response under tensile vs. compressive strain. A splitting of orbital energies $\sim$100 meV with octahedral distortions is found for the case of compressive strain which is much smaller than the $3d$ bandwidth. In sharp contrast, for tensile strain, no splitting is found although a strong orbital polarization is still present. Density functional theory calculations of the electronic properties reveal that the asymmetry results from a combination of strain effects and altered covalency in the bonding across the interfacial apical oxygen to the Al site, leading to the opening of a pseudogap in the heterostructure for tensile strain. Work at Argonne, including the Advanced Photon, is supported by the U.S. Department of Energy, Office of Science, and Office of Basic Energy Sciences, under Contract No. DE-AC02-06CH11357. [1] J.W. Freeland et. al. arXiv:1008.5618

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