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Spectroscopic findings in $SrTiO_3$ applications: $LaAlO_3/SrTiO_3$ and $La_{0.7}Sr_{0.3}MnO_3/SrTiO_3$ heterostructures

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Recently, a number of transport and magnetization studies have shown signs of exotic functionalities in $SrTiO_3$ based heterostructures, which are totally unexpected properties with no bulk analog in the constituent materials. However, it is still early stage to understand such a functionality, which limits improving $SrTiO_3$ applications. For this reason, we performed spectroscopic studies on the $SrTiO_3$ based heterostructures, such as $LaAlO_3/SrTiO_3$ and $La_{0.7}Sr_{0.3}MnO_3/SrTiO_3$ using element-specific techniques. For example, we found direct evidence for in-plane ferromagnetic order at the interface, with Ti^{3+} character in the d_{xy} orbital of the anisotropic t_{2g} band in $LaAlO_3/SrTiO_3$ heterostructure. Also, we found that the unexpected metal to insulator transition in $La_{0.7}Sr_{0.3}MnO_3/SrTiO_3$ is due to changes in Mn $3d$-electron confinement. These findings establish a striking example of emergent phenomena at oxide interfaces. In this presentation, I will introduce more details of spectroscopic findings on those heterostructures.