Dimensionally controlled metal-insulator transition in $LaNiO_3$ ultrathin films

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Since the possibility of orbital ordering and high-T_C superconductivity in two-dimensionally confined $LaNiO_3$ (LNO) layers is suggested by a theoretical study [1], LNO thin films and superlattices become a subject of great interest. However, recent experimental studies have revealed that both LNO films and superlattices exhibit thickness-driven metal-insulator transition (MIT) at a critical layer thickness of 3-4 ML [2,3]. In order to investigate how the electronic structure changes as a function of layer thickness, we have performed *in situ* photoemission spectroscopy (PES) on ultrathin LNO films grown on LAO substrates.

Figure 1 shows the obtained PES spectra. With decreasing film thickness below 10 ML, the intensity at the Fermi level (E_F) gradually decreases, leading to the pseudogap formation at E_F. The pseudogap eventually evolves into an energy gap at E_F below 2 ML, indicating the occurrence of the thickness-driven MIT at a critical layer thickness of 2–3 ML. These spectral changes are in good agreement with the prediction from layer cluster dynamical mean field theory calculation [4], strongly suggesting that the thickness-driven MIT is caused by narrowing of the bandwidth due to the dimensional crossover from 3D to 2D [5].

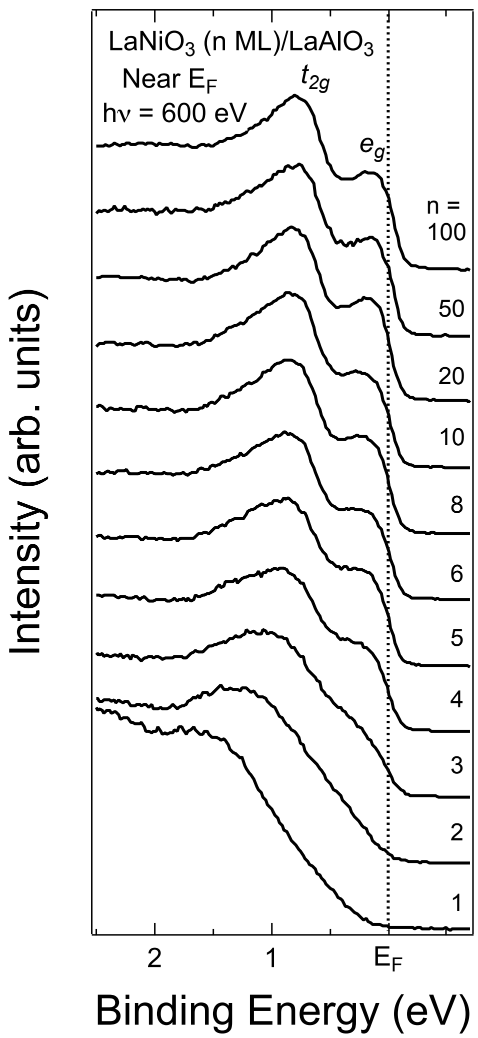

Fig.1 : PES spectra of $LaNiO_3$ thin films

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