Supporting Information for

Dimensionality Control of Magnetic Coupling at Interfaces of Cuprate-Manganite Superlattices

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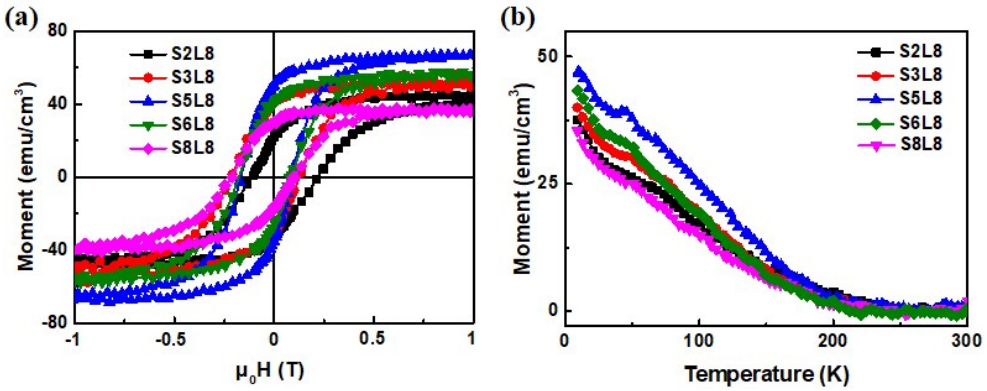

Fig. S1 (a) The magnetic hysteresis loops for a series of S(n)L(8) ($1 \leq n \leq 8$) superlattices measured at 5 K after +0.5 T in-plane field cooling process from room temperature. (b) The temperature dependence of magnetic moment for different S(n)L(8) superlattices from 5-300 K under 0.1 T test field.

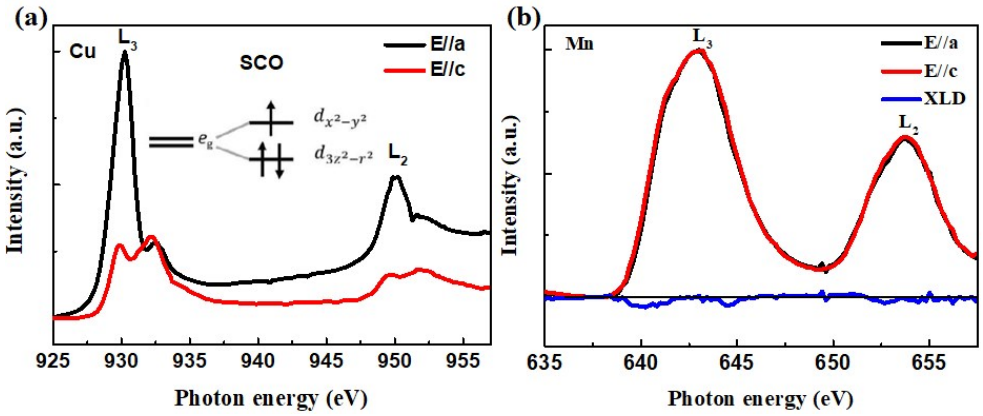

Fig. S2 (a) The XAS and XLD spectra at Cu *L*-edge and (b) the XAS spectra at Mn *L*-edge measured at room temperature with orthogonal linearly polarized light for the comparison LSMO and SCO single films. The negative XLD data indicate the preferential x^2-y^2 orbital is consistent with the traditional LSMO film growth on STO substrate. The larger in-plane XAS curve suggested most holes occupy the x^2-y^2 orbital in the SCO films.

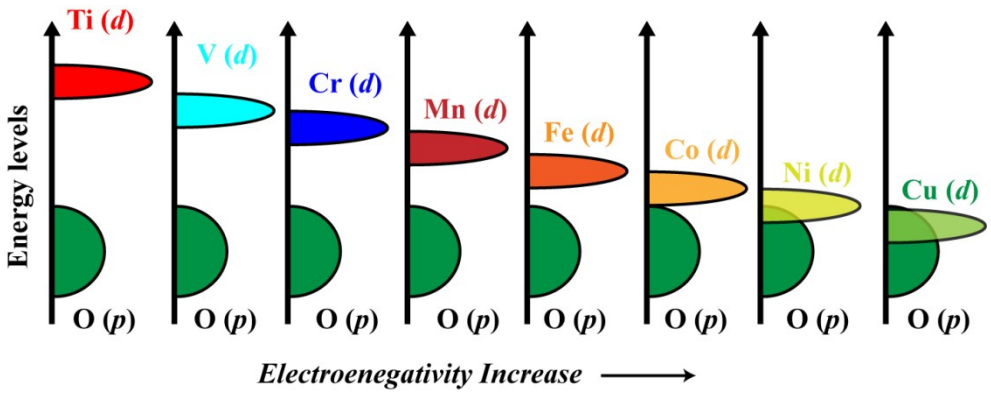

Fig. S3 Schematics of energy levels of transition metal *d* states with respect to oxygen *p* states in 3*d* transition metal oxide AMO_3 (*M* = Ti, V, Cr, Mn, Fe, Co, Ni and Cu). As the number of transition metal elements increase, the metal *d* level decrease. For titanates, the Ti-*d* states lie above the O-*p* by about 3 eV. For nickelates and cuprates, the Ni-*d* and Cu-*d* states even lie below the O-*p* states, leading to a "negative charge transfer" energy and strong hybridization.

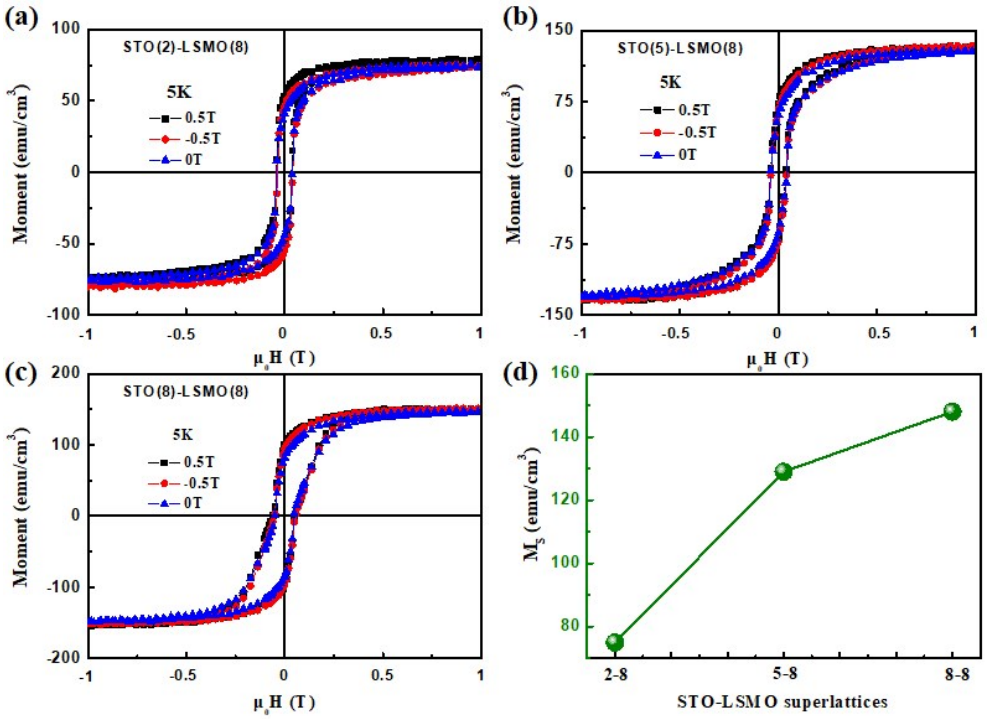

Fig. S4 (a-c) Magnetic hysteresis loops for STO(2)/LSMO(8), STO(5)/LSMO(8), and STO(8)/LSMO(8) superlattices measured at 5 K after zero-field-cooling and ±0.5 T in-plane field-cooling process from room temperature. (d) The saturation magnetization dependence on the STO layers thickness. The monotonical increase of the saturation magnetization with increasing superlattices thickness indicate the non-magnetic STO material cannot instead of the infinite SCO layer.