LONG LENGTH SCALE INTERACTION BETWEEN MAGNETISM AND SUPERCONDUCTIVITY IN La0.3Ca0.7 MnO3/ YBa2Cu3O7 SUPERLATTICES

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Abstract:

The competition between magnetism and superconductivity has been the focus of considerable research effort in recent years. The interplay between these two antagonistic long range orderings gives rise to quite exotic phenomena like spatial modulation of the order parameter, pi- junctions, etc, whose study, apart of its fundamental interest, may also open the way to important applications in the field of spintronics. The new oxides (high Tc (HTS) and colossal magnetoresistance (CMR) materials) offer a new scenario to explore this interplay at the nanometer scale. The spin polarization of the conduction band of the manganites is expected to suppress the superconductivity over very short length scales (0.1 nm) into the ferromagnet, and the short coherence length of the superconductor will make superconductivity to survive over very short length scales. In this talk, I will explore the issue of the ferromagnetic / superconducting (F/S) proximity effect in La0.3Ca0.7 MnO3(LCMO)/ YBa2Cu3O7 (YBCO) superlattices. We have grown LCMO/YBCO superlattices by high oxygen pressure sputtering technique epitaxially on (100) SrTiO3 changing the thickness of the individual layers between 1 and 15 nm. A structural study using xray refinement and transmission electron microscopy shows sharp interfaces with a high degree of structural perfection. Magnetization (SQUID) and transport measurements show the “coexistence” of magnetism and superconductivity. While the thinnest LCMO layers (3 unit cells) leaved the superconducting critical temperature almost unchanged, thicker LCMO layers result in a systematic reduction of the critical temperature over a wide thickness interval of the manganite layer. These results suggest a long nanometer scale length for superconductivity depression into the ferromagnet We discuss this resultin terms of the F/S proximity effect.

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