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Resonant X-ray diffraction/absorption and polarized neutron reflectivity studies of electronic and magnetic interface and proximity effects $YBa_2Cu_3O_7$/manganite multilayers

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The true origin of superconductivity in cuprates has remained elusive even after 30 years of its discovery. Numerous studies have indicated that even the normal state properties are very anomalous with a so-called pseudogap that appears already well above the superconducting transition temperature and competes with superconductivity for the electronic states at the Fermi level. The origin of this pseudogap is the subject of a controversial ongoing discussion. One possible candidate is a quasi-two-dimensional charge density wave order in the CuO_2 planes (Cu-CDW) order that has been observed in strongly underdoped samples. The study of the relationship of this Cu-CDW with SC has therefore become a very active field of research. In this context, it has already been demonstrated that the Cu-CDW can be strongly enhanced with external perturbations such as large magnetic fields or uniaxial pressure. An alternative approach that is explored in this thesis is to use the interface and proximity effects that occur in epitaxially grown multilayers of the cuprates HTSC's with perovskite oxides with magnetic and/or charge orders.

This thesis focuses on the manganites, which provide a wealth of different magnetic and charge/orbital orders. In particular, it reports studies of the proximity effect in artificial multilayers of the superconductor $YBa_2Cu_3O_7$ (YBCO) and the itinerant ferromagnet (FM) $La_{1/3}Ca_{2/3}MnO_3$ (LCMO) as well as the insulating, CE-type antiferromagnetic (AFM) and charge/orbital ordered $Nd_{1-x}(Ca_{1-y}Sr_y)_xMnO_3$ (NCSMO). The present work has been possible thanks to the collaboration between the "Magnetism and Superconductivity" Group at the University of Fribourg and Paul Scherrer Institute, Switzerland

The PNR studies of YBCO/LCMO multilayers have revealed the ferromagnetic properties of the LCMO layer in the vicinity of the interface and have shown that the thickness of an interfacial layer with a ferromagnetic order, a so-called dead layer, can be strongly varied via the growth conditions.

The combined XAS and RIXS/REXS studies in Chapter 6 have shown that in these cuprate/manganite multilayers a Cu-CDW order can be induced in the YBCO layers that are nominally optimal doped and thus void of a CDW order in the bulk. They have also demonstrated that the strength and the correlation lenth of the Cu-CDW can be modified via the tolerance factor of the manganite or by applying a large magnetic field. Finally, the studies in reveal that a new kind of Cu-CDW with a different orbital character, a much shorter wave vector and a larger correlation length than in the bulk cuprates can be induced in such multilayers.

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