Experimental Report

16/09/2012

Proposal:	**5-42-304**	**Council:**	10/2011	
Title:	Interfacial Effects on [SrMnO3]/[LaMnO3] multilayers			
This proposal is a new proposal				
Researh Area:	Physics			
Main proposer:	**WASCHK Markus**			
Experimental Team:	WEBER Alexander WASCHK Markus			
Local Contact:	WILDES Andrew			
Samples:	SrMnO3/LaMnO3			

Instrument	Req. Days	All. Days	From	To
D17	9	7	10/09/2012	17/09/2012

Abstract:

We propose a polarized neutron reflectometry study on [(SrMnO3)j/(LaMnO3)k]N. These multilayers are grown epitaxially on SrTiO3 (STO) (100) single crystals by an oxide-assisted Molecular Beam Epitaxy and alternatively by high pressure oxide sputtering. With varying layer thickness we want to determine the origin and influence of the interfacial e ffects, namely the enhancement of ferromagnetism in LaMnO3 (LMO) due to the proximity SrMnO3 (SMO). By changing the LMO thickness the range of enhanced ferromagnetism can be determined. By varying the thickness of SMO we can make conclusions on the origin of the interfacial effect, like roughness and strain.

Experimental Report on Beam Time 5-42-304: Interfacial Effects on [SrMnO3]/[LaMnO3] multilayers

Alexander Weber and Markus Waschk

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Abstract

During this beam time we were able to measure three samples of $LaMnO_3$/$SrMnO_3$ multilayers grown epitaxial on $SrTiO_3$. Two of these samples showed a magnetic contrast. This is due to the induced ferromagnetic moment within the $LaMnO_3$ caused by the interface to the $SrMnO_3$. A thorough data evaluation will show the magnetic depth profile within the $LaMnO_3$ layers. The magnetic moment per Mn-atom within the $LaMnO_3$ layer should be dependent on the $LaMnO_3$ layer thickness and should exhibit a correlation to the interface roughness .

1 Introduction

The perovskites $LaMnO_3$ and $SrMnO_3$ are antiferromagnets on their own. Heterostructures of these oxides however show a magnetic moment within the $LaMnO_3$ layers, induced by the interface to the $SrMnO_3$ layers. We did careful thickness dependent SQUID magnetometry measurements on samples with different $LaMnO_3$ layer thicknesses. From these measurements we conclude, that the interface effect is limited in range. Performing neutron reflectivity measurements with polarized neutrons gives the magnetic depth profile within the individual $LaMnO_3$ layers.

2 Results

We measured three samples at different magnetic fields and at different temperatures. In Fig. 1 a $\theta - 2\theta$ is shown, measured at 10 K with a field of 0.5 T applied. Fig. 2 shows the first two Bragg peaks measured with higher statistics. As expected, the contrast between the two polarization channels varies with the applied field and depends on the temperature.

The gained data needs to be compared to simulations to be able to give the magnetic depth profile.

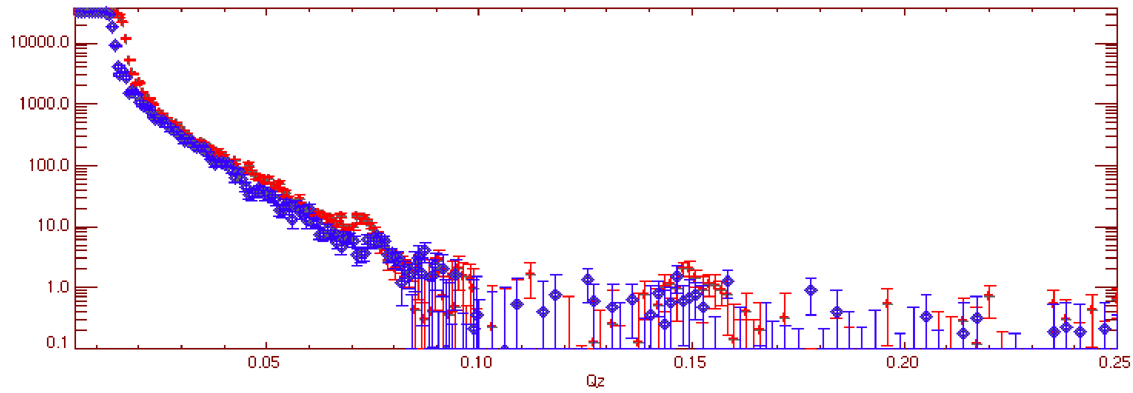

Figure 1: *Neutron reflectometry scan with polarized neutrons of a* $LaMnO_3SrMnO_3$*multilayer at 0.5 T at 10 K. Plotted is the number of counts vs.* Q_z *in* $Å^{-1}$*. The spin up channel is plotted red, the spin down channel blue. The critical edge and the first two Bragg peaks show a clear difference for the two channels.*

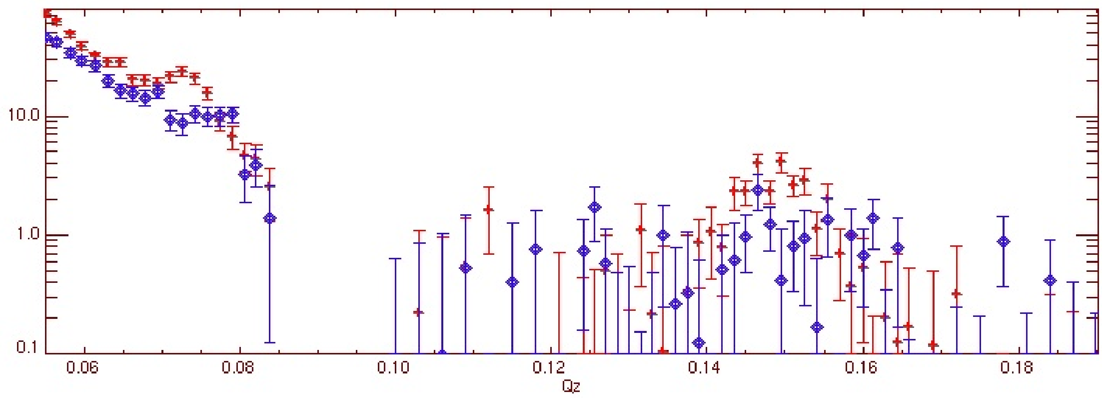

Figure 2: *The first two Bragg peaks measured with higher statistics but lower resolution. Here the contrast due to the magnetization is clearly pronounced.*

3 Conclusions

The overall results match our expectations nicely. Careful data evaluation is needed to make statements on the influence of roughness and layer thickness on the magnetization. Sadly, due to troubles with the instrument controlling software, which hang up several times, we lost approximately two nights and a day of measurement time. Moreover, due to the problems with the reactor in the last cycle our measurement time was already shortened by two days. Thus, we were unable to complete our measurement schedule.