**Motivation**
- growing and characterization of ferromagnetic oxides for investigation of spin dynamics in ferromagnetic resonance or spin pumping experiments
- materials:
  - La$_2$Sr$_2$MnO (LSMO) which is expected to have a high spin polarization of conduction electrons
  - YFe$_2$O$_4$ (YIG) which exhibits ferromagnetism well above room temperature and exceptionally low damping
- growing:
  - PLD with RHEED, our best layers are grown with this conditions
  - metal layers were deposited with magnetron sputtering or electron beam evaporation in situ (without breaking the vacuum) to ensure a perfect interface

**SQUID measurements I: LSMO with different metal layers**
- reactive metals like Ti, Cr and Cu lead to a decrease of the magnetization
- these interface reactions are not observed if the sample is left in air for several days prior to metal evaporation
- Further measurements have shown:
  - 1 nm of Titanium is enough to destroy the complete magnetization of a 10 nm LSMO layer
  - 4 nm SRO or STO layer can protect the LSMO

**TEM measurements I: LSMO with different metal layers**
- STEM/HAADF images from a LSMO/Au sample (A) show nice periodic crystal structure
- images from a LSMO/Ti sample (B) show that the crystal structure of the LSMO film is not as expected
- It appears to have a periodic "cell doubling" along the growth direction, confirmed by line profiles (C)
- Effect of oxygen deficiency?
- EELS analysis across LSMO layer shows O is present in the Ti layer (D)

**X-Ray measurements I: LSMO with different metal layers**
- Reciprocal space maps around the 103 substrate peak for various stacks
- Noble metals like Gold and Platinum have no influence of the LSMO structure
- in samples with different reactive metals like Cr, Ti, and Ta the LSMO layer streak is no longer present
- instead of this peak a new peak with larger lattice constant, but still pseudomorphic, is observed

**X-Ray measurements II: YIG**
- SQUID measurement at RT shows for 20 nm YIG a coercive field strength of $H_c = 0.6$ Oe and $H_m = -0.7$ Oe
- paramagnetic amount from GGG substrate was subtracted from the measurement
- YIG/Cu and YIG/Cu/CoFe multilayers have been investigated by ferromagnetic resonance. For the trilayer a broadening of the line is observed when the thickness of the Cu layer is reduced to 3 nm. A likely explanation is the observation of spin pumping and increased damping by the close proximity of the CoFe.

**TEM measurements II: YIG**
- TEM image of a 10 nm YIG layer
- because of the small lattice mismatch YIG grows perfectly on the GGG

**Conclusion**
- for non-noble metals like Cu, Ta, or Ti a strong interface reaction takes place which destroys the magnetism at the interface, only noble metals like Au or Pt guarantee an undisturbed LSMO layer
- Au and Pt have strong spin orbit coupling and short spin diffusion lengths this limits the options for hybrid spin transport structures
- for YIG and LSMO single layer materials with state of the art quality could be achieved and oxide/metal hybrid structures have been fabricated

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