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Interfacial control of phase transitions in magnetic oxide heterostructures through electric field for magnetic switching

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Tuning magnetic oxide phases via redox reactions across their heterointerfaces makes them useful for spintronic and memristive device applications. With controlled film-substrate interfaces and using small electric field, oxidation/reduction reaction occurs which leads to a reversible phase transition. In this work, we achieve magnetic switching of Fe3O4/Nb:SrTiO3 heterosturctures by applying electric field. We grow Fe3O4 films with different growth temperatures by pulsed laser deposition. The quality of the magnetite films is checked by different techniques e.g. AFM and XMCD. Using magnetometry, we detect the Verwey transition which is a strong indicator of the oxygen content in the Fe3O4 films. We observe a strong change in the Verwey transition with applied electric field. This can be explained by oxygen diffusion through the interface which leads to a reversible phase transition from Fe3O4(magnetite) to ɣ-Fe2O3(maghemite). Additionally, we investigate the structural transitions using x-ray diffraction (XRD) and insitu-wide angle scattering (WAXS).

Primary authors: Dr HAMED, Mai Hussein (Forschungszentrum Jülich GmbH - Jülich Centre for Neutron Science); Mrs XU, Yifan (Forschungszentrum Jülich GmbH - Jülich Centre for Neutron Science); Dr BEDNARSKI-MEINKE, Connie (Forschungszentrum Jülich GmbH - Jülich Centre for Neutron Science); Dr QDEMAT, Asmaa (Forschungszentrum Jülich GmbH - Jülich Centre for Neutron Science); KENTZINGER, Emmanuel (Forschungszentrum Jülich GmbH - Jülich Centre for Neutron Science); BRÜCKEL, Thomas (FZJ)

Presenters: Dr HAMED, Mai Hussein (Forschungszentrum Jülich GmbH - Jülich Centre for Neutron Science); Mrs XU, Yifan (Forschungszentrum Jülich GmbH - Jülich Centre for Neutron Science)

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