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# Electric Field Control of the Crystalline structure of $La_{0.7}Sr_{0.3}MnO_3$/ $0.7Pb(Mg_{1/3}Nb_{2/3})O_3 - 0.3PbTiO_3$(001) correlation with magnetoelectric coupling.

## ABSTRACT

Magnetoelectric coupling is the phenomenon that the magnetization is controlled by electric field,or vice versa.It can be explained by Maxwell's equation that magnetic interaction and electric charge motion are intrinsically coupled.It can be realized by strain mediation and charge coupling. Voltage control of magnetism is very useful in magnetic storage devices and advanced CMOS,which requires the non-volatile and energy efficient properties.

The heterostructure composing of magnetic thin films and ferroelectric substrate contributes to the ME coupling. $0.7Pb(Mg_{1/3}Nb_{2/3})O_3 - 0.3PbTiO_3$ exhibits the excellent piezoelectric properties and ferroelectricity due to its perovskite structure.$La_{0.7}Sr_{0.3}MnO_3$ shows strong ferromagnetization via double exchange interaction of $Mn^{3+} and Mn^{4+}$.The large lattice mismatch between LSMO and PMN-PT causes strain-mediated ME coupling in the heterostructure $La_{0.7}Sr_{0.3}MnO_3/0.7Pb(Mg_{1/3}Nb_{2/3})O_3 - 0.3PbTiO_3(001)$. Meanwhile,by applying the electric-field the charge-mediated coupling also plays an import role in ME coupling.

The samples of heterostructure LSMO/PMN-PT(001) are grown by High Oxygen Pressure Sputter Deposition(HOPSD).In order to understand more about how electric field influences the LSMO/PMN-PT system,the investigation of the crystalline structure under different voltage via reciprocal lattice map trough the GALAXI is implemented.The polarization as a function of the electric field is also measured to identify the coercive field and correlate the changes of polarization with the crystalline structure.Under different voltage,the polarisation variants deduced by reciprocal lattice map has the obvious shifts.It indicates that the 109° ferroelastic domain switching in PMN-PT is the main reason for magnetisation-electric butterfly loop.

The second part of the report is the measurement of magnetization under the different parameters such as temperature,magnetic field and electric field.The results show that the collective effect of strain-mediation and charge mediation in magneto-electric coupling and the change in strain behaviour from butterfly loop to linear loop is observed as a function of temperature.