Strain induced and its consequences in multiferroics

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Strain is a powerful tool for tuning physical properties of functional perovskite oxides like polar and/or magnetic orders in multiferroics. This parameter can be generated using various paths including external hydrostatic pressure, biaxial and uniaxial stresses. In case of the model multiferroic $BiFeO_3$ (BFO), the structure i.e. polar atomic shifts and oxygen octahedra tilts which is closely linked to its ferroelectric and magnetic properties shows pressure instabilities [1]. We took advantage of this strain sensitivity to study how coherent acoustic phonons can be generated by a ultrafast pulsed laser which can be seen in somehow as a "uniaxial pressure" [2]. We also used biaxial stresses through various substrates to tune the whole properties of BFO showing how misfit strain can 1) affect BFO phases allowing original mixed-phase state [3]; 2) tune the critical temperatures of antiferromagnetic and ferroelectric transitions [4]; 3) modify the ferroelectric, dielectric and piezoelectric properties [5]; and 4) control the magnetic properties and spin arrangements [6]. Finally, we will also show results in hybrid or artificial multiferroics i.e. heterostructures made of magnetic and ferroelectric materials. In these systems, the so-called magnetoelectric coupling can be mediated at the interface through strain. Here, we showed how the magnetic (AntiFerroMagnetic and FerroMagnetic) states of a FeRh film can be controlled through strain by applying an electric field on an underlying $BaTiO_3$ ferroelectric substrate [7]. In this talk, I will illustrate these remarkable features by stressing the key role of the strain.

References

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