Contribution ID: **18** Type: **not specified**

Coupling of GHz phonons to ferroelastic domain walls in SrTiO3

SrTiO3 (STO) is a dielectric perovskite that shows quantum paraelectric behavior at low temperatures. It is widely used as a substrate for the growth of perovskite layers and has been intensively studied for its various structural phase transitions. The elastic behaviour of STO has been studied since the 60ies and has recently attracted attention due to the high mobility of domain walls in the antiferrodistortive phase.

We use time domain Brillouin-scattering techniques for studying the linear and nonlinear acoustic response of STO across its ferroelastic transition at Tc = 105 K. We excite a metallic transducer film on the surface in order to generate high amplitude strain pulses into the STO crystal underneath. Using ultrafast X-Ray-diffraction we are able to observe the expansion of the transducer and thus determine the induced transient strain in STO. Above Tc we observe that for a strain amplitude of 0.18% the sound velocity for compressive strain exceeds the tensile strain velocity by 3%. This behavior can be modeled in a linear chain and is explained by the anharmonicity of the interatomic potential. Below Tc we observe a giant slowing down of the sound velocity by 12% which we interpret as superelastic response due to the coupling of the GHz phonons to ferroelastic domain walls. This has so far only been observed for lower frequency phonons. We conclude that this phenomenon occurs for GHz sound only when the strain amplitude is large enough to couple to domain walls because the unit cell deformation exceeds the tetragonal distortion of the domains. We argue that the relevant time scale that makes superelastic behavior possible also for low strain amplitudes at low frequencies is determined by the time T = D/vs it takes sound to propagate through the average size D of the domains. The observed phenomena can also be interpreted in terms of a transient phase which is established under high positive and negative pressure, however, we prefer a discussion as a non-equilibrium process in a domain-forming phase.

Primary author: Mrs MAERTEN, Lena (University of Potsdam)

Co-authors: BOJAHR, André (University of Potsdam); SCHICK, Daniel (Helmholtz-Zentrum berlin für Materialien und Energie); Mr HERZOG, Marc (Fritz-Haber-Institut der Max-Planck-Gesellschaft); BARGHEER, Matias (Universität Potsdam/HZB); Mr GOHLKE, Matthias (University of Potsdam)

Presenter: Mrs MAERTEN, Lena (University of Potsdam)

Session Classification: Molecular dynamics 1