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Competition between structural instabilities in strained ABO3 nanostructures

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In spite of their simple structure, the family of ABO3 compounds present a large variety of phase transitions involving polar and non polar distortions as well as magnetic orders. Here we will discuss the microscopic origin of these properties and how they are affected in nanostructures through the concept of structural instabilities. We will from the fact that the ferroelectric (FE) and the antiferrodistortive (AFD) instabilities are in competition at the bulk level and are strongly sensitive to pressure and strain. From these considerations we will describe the possibilities to tune this FE/AFD competition by playing with strain and interface engineering. To that end we will first consider the effect of epitaxial strain on BaTiO3, SrTiO3, PbTiO3 and CaTiO3 thin films. In all of these compounds, the epitaxial strain can strongly modify the phase diagrams giving rise to different pure or mixed FE/AFD ground states. We will also extend the discussion on magnetic perovskites like CaMnO3 and will present the different strategies to induce or tune multiferroic properties. Second we will focus on the interface effects as present in bicolor superlattices. As an example we will examine the case of PbTiO3/SrTiO3 superlattice and will show that it exhibits totally unique properties arising from unexpected FE/AFD couplings at the interface between the layers. We will then investigate to which extent similar types of FE/AFD couplings can be induced in other artificially layered systems. We will consider different bicolor superlattices obtained from the combination of PbTiO3, SrTiO3, CaTiO3 and BaTiO3 and discuss how the intrinsic tendency of these compounds to favor either the FE or the AFD instabilities shifts or even suppresses the FE/AFD coupling.

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