Coupling of phase field models for ferroelectric and ferromagnetic layers in multiferroic heterostructures

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ABSTRACT

Heterostructures of ferroelectric and ferromagnetic layers are commonly used to obtain electromagnetic effects. The elastic coupling between the layers is widely acknowledged as the main mechanism responsible for the electro-magneto interaction. Within this contribution we study the coupling of ferroelectric and ferromagnetic layers with well-defined interfaces. The intention is to simulate the switching of the magnetization with the help of electric fields, which has been studied experimentally in [1]. Each layer is simulated by using mechanically coupled phase field modeling, whereby the approaches presented in [2] and [3] will be used. The strains in each layer depend on the direction of the polarization/magnetization. A mismatch of these strains will be compensated by local deformations at the interface as the coupling results from the coherent deformation at the interface. This leads to the possibility to alter the magnetization direction by changing the electric polarization and vice verse. Numerical simulations will illustrate the evolution of the ferroic microstructures with a focus on the strain coupling and the resulting interactions between layers.

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