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Electric-Field Control of Magnetization and Electronic Transport in Ferromagnetic/Ferroelectric Heterostructures (Springer Theses)

Sen Zhang

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This book mainly focuses on the investigation of the electric-field control of magnetism and spin-dependent transportation based on a Co40Fe40B20(CoFeB)/Pb(Mg1/3Nb2/3)0.7Ti0.3O3(PMN-PT) multiferroic heterostructure. Methods of characterization and analysis of the multiferroic properties with in situ electric fields are induced to detect the direct magnetoelectric (ME) coupling. A switchable and non-volatile electric field control of magnetization in CoFeB/PMN-PT(001) structures is observed at room temperature, and the mechanism of direct coupling between the ferroelectric domain and ferromagnetic film due to the combined action of 109° ferroelastic domain switching in PMN-PT and the absence of magnetocrystalline anisotropy in CoFeB is demonstrated. Moreover, the electric-field control of giant magnetoresistance is achieved in a CoFeB-based spin valve deposited on top of (011) oriented PMN-PT, which offers an avenue for implementing electric-writing and magnetic-reading random access memory at room temperature. Readers will learn the basic properties of multiferroic materials, many useful techniques related to characterizing multiferroics and the interesting ME effect in CoFeB/PMN-PT structures, which is significant for applications.

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