Electric-field control of magnetism by piezoelectric effects

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There is a growing interest in various methods allowing for controlling magnetic properties by an electric field [1]. A strong sensitivity of magnetic properties on carrier density and strain in dilute ferromagnetic semiconductors such as (Ga,Mn)As has allowed to affect magnetism by gaiting or by applying an electric field to a piezoelectric material cemented to a ferromagnetic sample [2]. It has recently been demonstrated that piezoelectricity specific to a wurtzite dilute magnetic insulator (Ga,Mn)N allows to affect magnetization by an magnetoelectric coupling [3]. In this system, the application of an electric field stretches the elementary cell along the wurtzite c axis and, thus, controls the sign and magnitude of single-ion magnetic anisotropy specific to Mn^{3+} ions in GaN. A corresponding theory has been developed and showed that it describes the experimentally determined dependence of magnetization on the electric field as a function of the magnetic field and temperature [3]. In this way, our work bridges two fields of research developed so far independently: piezoelectricity of wurtzite semiconductors and electrical control of magnetization in hybrid and composite magnetic structures containing piezoelectric components.

References:

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