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Exchange biasing with multiferroic: electric field effects on magnetic and magnetotransport properties

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Room-temperature multiferroic materials are scarce and display a weak magnetoelectric coupling and thus huge difficulties exist for controlling the magnetic state by using an electric field or viceversa. A possible alternative to circumvent this limitation is to exploit the clamping of ferroelectric and antiferromagnetic domains in biferroic materials and use a suitable exchange-bias existing with ferromagnetic materials to tune the magnetic response of the ferromagnet. In this presentation we shall overview recent experiments on exchange-biasing using hexagonal $YMnO_3$ biferroics and Permalloy as a soft-ferromagnet. Exchange-bias on ferromagnetic materials is most commonly evidenced by their magnetic response, although magnetotransport measurements are also very adequate to monitor the exchange bias. We will present and discus first how exchange-bias is manifested and monitored. Next, we will describe the effects of an electric field, biasing the ferroelectric (and antiferromagnetic) epitaxial layer, on the exchange bias. We will show that under appropriate conditions, magnetization can be switched by application of a suitable electric field. We will discuss the significance of the results with particular attention to role of current leakages across the ferroelectric.

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