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Electric control of magnetism

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Electric control of magnetism is currently drawing much attention due to its overwhelming advantage in energy consumption compared to magnetization manipulation by magnetic fields or spin polarized currents.

Different strategies have been proposed to exploit electric fields to affect the magnetization, magnetic anisotropy, exchange bias, Curie temperature, spin transport, etc., of magnetic systems. First observed in diluted magnetic semiconductors [1], such demonstrations were more recently extended to ferromagnetic transition metals [2] generally used in spintronics devices such as magnetic tunnel junctions due to their higher Curie temperature. This goal also boosted the field of multiferroic materials or architectures in which magnetic and ferroelectric orders can coexist and be coupled [3].

In this lecture we will review the progress in this field as well as the different mechanisms that allow such electric field control of magnetism including spin-dependent screening, interfacial bonding, surface/interface Rashba effect.

[1] Ohno, H. et al. Electric-field control of ferromagnetism. Nature 408, 944–946 (2000).; I. Stolichnov et al., Non-volatile ferroelectric control of ferromagnetism in (Ga,Mn)As, Nat. Mater. 7, 464-467 (2008).
[2] M. Weisheit et al. Electric-field induced modification of magnetism in thin-film ferromagnets; Science 315, 349–351 (2007).
[3] see for example the special issue of Comptes rendus de l'Académie des Sciences 16, 2 (2015)