Controlling magnetism by electrochemical approaches

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The control of magnetic properties in a reversible way is of interest for fundamental science understanding and for applications. Typically, the concepts require nanostructured materials and morphologies, in many cases in the form of thin films. New opportunities can be opened by employing electrical charges at interfaces to the magnetic materials exposed to electrolytes. In this case, an applied electrical potential results in large polarization at the interfaces, leading to substantial reversible changes of the magnetic properties at the surfaces. In case of extremely thin films, it has been demonstrated that complete on-off switching can be achieved. An extension of these magnetoelectric effects, still employing electrolytes, but now including reversible ion-intercalation driven magnetic control, addresses also the bulk materials volumes. The concept is demonstrated for various ferromagnetic spinel oxides, where a large and fully reversible change in room temperature magnetization is observed.