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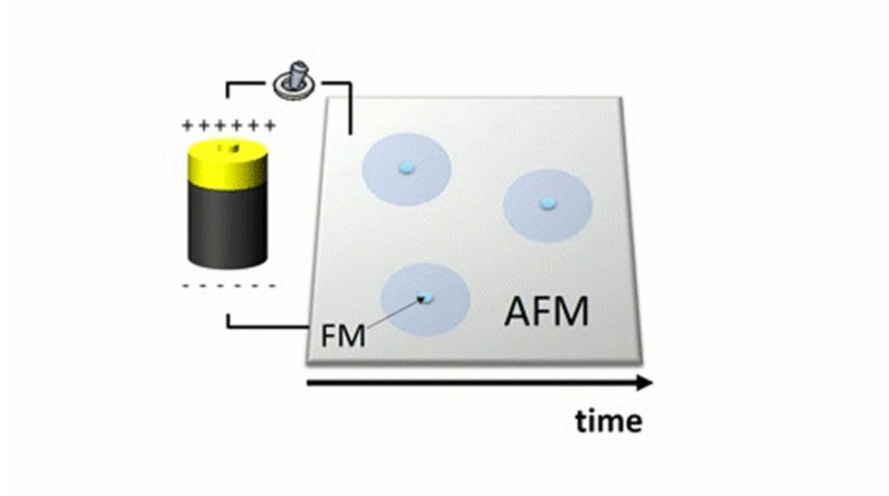
Tunable time-dependent magnetoelectric response



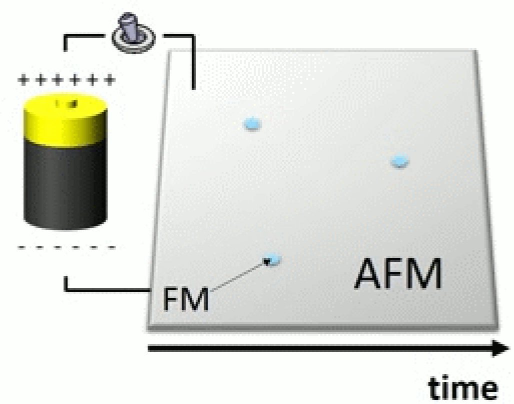
A joint research conducted by the UAB, ICMAB, ICN2 and ALBA Light Synchrot reveals the possibility, under certain conditions, to manipulate magnetization i very effective manner through electric fields in structures combining magnetic piezoelectric materials. This research may have applications in reducing the ene consumption of computers, as well as in elements of security where informa must be visible only for a short period of time.

We can find magnetic materials in a long list of devices we use on a daily basis. The one best know refrigerator magnet. But, of course, it is not the only example. Many magnets similar to refrigerator mag used to store information. In particular, the text you are reading right now is likely to be stored in m based on magnetic materials. In these memories the magnets point their north pole up or down repre "0"s or "1"s, which is the basic memory element.

However, manipulating the north pole of such magnets is not easy. For this purpose, normally, magne are used. But the generation of these fields is very expensive from an energetic point of view. The rea this is that the generation of magnetic fields is done through the circulation of an electric curre Generating this current already has a high energy cost. But, more importantly, the current circulation di heat by Joule effect, which makes it necessary to incorporate cooling systems that require even more Since memory elements are becoming smaller, the needed current density is progressively higher, hen

is a growing need to cool these devices. Therefore, finding new routes that do not require the use of m
fields for the writing of information onto magnetic materials is important to promote a new gener
computers capable of consuming less energy and, therefore, being more sustainable from the econo
environmental points of view.

One of the possible routes that would allow minimizing or avoiding the presence of magnetic fields w
the use of electric fields (i.e., voltages) for writing. However, this is only possible in the pres
magnetoelectric coupling, which is not always easy to obtain. The use of electric fields would allow bui
systems that would work in open circuit conditions. In open circuit, the transport current does not e
therefore the energy consumption, the heat dissipation and the cooling requirements are mi



Sketch of the transition between antiferromagnetic (AFM) and ferromagnetic (FM) states depending on the applied electric voltage.

Using this premise (i.e., the use of electric fields to manipulate magnetization), it is interesting t
structures where magnetic and piezoelectric materials are combined. Piezoelectric materi
shrunk/expanded upon application of an electric field. If this movement is transmitted to an adjacent n
material, magnetoelectric coupling takes place, thus resulting in the possibility of modulating the magn
by electric field. A recent collaborative study between the UAB, ICMAB, ICN2 and ALBA, carried ou
framework of the SPINPORICS and #ESRAM projects, and published in the journal ACS Applied Ma
Interfaces has revealed that, under certain conditions, it is possible to manipulate very effecti
magnetization in a magnetic/piezoelectric structure. Importantly, the study unexpectedly reveal
magnetization can be manipulated by electric field in a way that its response can be made time-dep
This could be very interesting for security elements, where it may be desirable for the information to b
only for a short period of time to avoid the possibility of making copies.

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References

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http://pubs.acs.org/doi/abs/10.1021/acsami.7b00476

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