Scilight

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Studying the magnetoelectric effect can lead to a wide variety of technological advances

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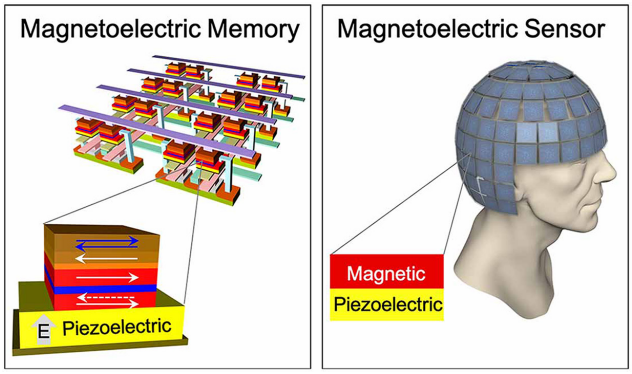
The ability to efficiently control magnetization and surface electric charges is important for advances in wide-ranging technologies from computing to biomedicine.



The magnetoelectric (ME) effect permits the control of a material's magnetic properties by applying electric fields and its electric polarization by applying magnetic fields. A new perspective by Jia-Mian Hu and Ce-Wen Nan examines the outlook of using the ME effect in two potential applications.

To push computer performance beyond its current limit, the ME effect provides a possible solution in spin-based computing, where computational information is encoded in the orientation of magnetization vectors. Depending on the constituent material, ME switching can be mediated in several different ways. The effect can be used to develop ultralow-heat-dissipation computer memory and logic gates by flipping magnetization with voltage applied through a transistor. According to Hu and Nan, with decreasing transistor size, the key challenge to address for ME applications in spin-based computing is the realization of ME switching under low voltage and zero magnetic field.

The second use of the ME effect the authors discuss is the development of ME sensors for detecting biomagnetic fields. Because magnetic fields generated in the human body are weak and inhomogeneous, detectors require high spatial resolution and sensitivity. Devices currently used require bulky cooling systems. Because ME sensors do not need any heating or cooling components, they are ideal for use in biomagnetic field detection. However, the authors note that both the size and the detection limit of ME sensors must first be reduced.

Using the ME effect is an energy-efficient way to control magnetism at small scales and allows for source-free detection of surface electric charges. Further research on the ME effect will likely open up a wide variety of discoveries and new technologies.

Source: "Opportunities and challenges for magnetoelectric devices," by Jia-Mian Hu and Ce-Wen Nan, *APL Materials* (2019). The article can be accessed at https://doi.org/10.1063/1.5112089.