

Description for the general public

Vast amount of electronic devices use magnetic data storage. It is true for both magnetic hard disc drives (HDD) widely used since the end of XX century and novel magnetic random access memories (MRAM) that are currently gaining their market share. However, every magnetic memory has serious disadvantage. There is a danger of loss the saved data due to the externally applied magnetic field. This downside plays an important role in medical facilities or laboratory applications where strong magnets are present. For example, it is not save to come close to a strong magnet having a credit card in a pocket, because it will be vulnerable to loss of functionality.

There exist materials, that have magnetic features, but remain considerably insensitive to the external magnetic fields and they are not the source of any stray magnetic fields – they are called antiferromagnets. Therefore, their application in data storage seems to be very attractive. Memory made of antiferromagnet would be inerasable with external magnetic field. Materials of such kind have been known for long time and even in 1970 Louis Néel receiving the Nobel Prize for the research on antiferromagnets pointed out that although they are very interesting, they do not seem to have any applications.

Indeed, these materials seem to stay behind materials traditionally conceived as magnetic, i.e. ferromagnets both in terms of applications and scientific research. Nevertheless, the most recent reports show that using electrical current it is possible to control the magnetic order in some group of antiferromagnets for example CuMnAs (copper manganese arsenide). It has been shown, that material insensitive to external magnetic field reacts to application of the electrical current, and more precisely to the direction in which current is flowing. Antiferromagnetic axis, that is the direction along which all magnetic moments are applied, can be rotated with current. The phenomenon described above potentially paves the way to apply these materials in data storage.

This project aims at making a next step. Having learned that current can be a useful tool to control the magnetic state of antiferromagnetic CuMnAs, we want to find the answer what would be the effect of external electric field on semi-metallic antiferromagnet. Determination and description of the effect is the main challenge. It has been shown for many ferromagnetic systems and also antiferromagnetic oxides that is it possible to achieve considerable control of magnetism with electrical fields. The project will contribute to the the current state of knowledge about antiferromagnets and fits well to the newest achievements in the discipline exploiting far-reaching perspective of application antiferromagnets as an active elements of memory.