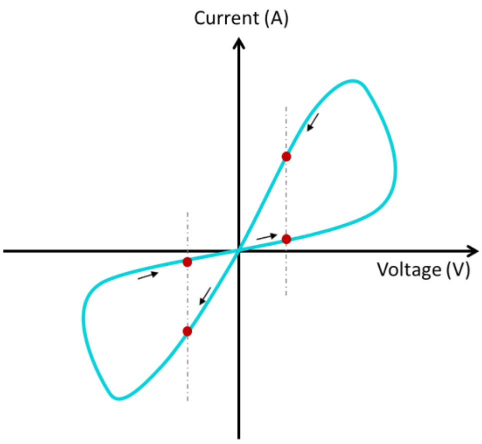
Nanotechnology is an interdisciplinary scientific field that primarily works on the production and research of materials with unique properties resulting from their structure and size. It is closely related to one of the leading trends in technology - miniaturization. It assumes reducing the size of devices while maintaining their full functionality. The constant pursuit of device miniaturization drives the progress of nanotechnology, which in turn leads to the development of new materials and the discovery of new phenomena. It often lead to the emergence of innovative technological solutions. One of the areas where this trend is particularly visible is semiconductor electronics. Achievements in this area affect the lives of all of us. We observe them eg. in computers or smartphones. The constantly growing requirements for electronic devices make it necessary to increase their efficiency and the speed of information processing. Therefore, these devices must not only be small, but also have a high response speed and memory capacity, which is achieved by integrating semiconductor circuits. One example of highly miniaturized integrated circuits are data storage devices. The limitations of traditional memory, as well as the high performance and power consumption requirements of memory systems, force the continuation of work on miniaturization simultaneously with optimization of memory structures. They also motivate the development of new memory structures, which are based on innovative materials and mechanisms occurring in them and will allow the combination of SRAM switching speed with storage density comparable to DRAM with non-volatile Flash memory.

Undeniably, innovative materials with great potential for the memory market are those showing a memristive effect. Memristors (resistors with memory) are considered revolutionary, mainly because they can store data without the need for a constant power supply, unlike standard RAM. This effect is manifested by the occurrence of resistive switching. For such materials, a pinched hysteresis loop is observed in the I-V characteristics (as shown in the figure). This property allows these elements to distinguish between two different current values for the same voltage. Therefore they are considered as suitable structures for devices with non-volatile semiconductor memory (e.g. RRAM), logic operations, or neuromorphic calculations. So far, many RRAM architectures based on different dielectric and conductive materials have been proposed. Examples of such materials are some transition metal oxides, e.g. TiO_2, HfO_2 or ZnO. Less popular material with potential for applications in RRAM memory structures is CuO. The memristive effect was also observed in thin films of copper (II) oxide obtained from an aqueous solution using the hydrothermal method at the Institute of Physics of the Polish Academy of Sciences.



A better understanding of both the physics of memory devices, in particular the resistive switching mechanisms, and the influence of material properties on the memristor effect is very important to further improve RRAM. The project will lead to a comprehensive analysis of CuO thin films, including the understanding of resistive switching mechanisms (formation and breaking of conductive filaments or charge trapping) and the relationship of material effects (e.g. grain size) with the characteristics of memory structures (e.g. retention) of the MIM type based on CuO films.