

# A material with promising properties

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Researchers at the University of Konstanz have developed a method for synthesising Europium (II) oxide nanoparticles, a ferromagnetic semiconductor that is relevant for data storage and data transport

Ferromagnetic semiconductors are promising functional materials that can be used in the field of spin-based electronics (spintronics).

Spintronics is of crucial importance for the storage and transport of information. The researchers also demonstrated that the nanoparticles have magnetic [properties](#) conferred by their structure. The results of the joint research project have been published in the 20 November 2017 issue of the scientific journal *Advanced Materials*.

The properties of anisotropic and magnetic nanoparticles are at the centre of the research project. Anisotropic means that the shape and the magnetic, optical or electronic properties are not identical for all spatial directions of the particle. This in turn makes it possible to investigate not only the new and often improved properties of nano-structured [materials](#), but also the additional properties caused by anisotropy.

Producing nanoparticles from [ferromagnetic semiconductors](#) such as Europium(II) [oxide](#) constitutes a huge challenge, especially in anisotropic geometry. "The aim is to deepen our understanding so that we can modulate and access the properties of nano-systems on demand," says lead author Trepka. Using their special method, the researchers succeeded in producing high-quality and anisotropic EuO-nanoparticles that can be used to observe structure property effects.

The method is based on a two-stage process. In a first step, a [hybrid material](#) consisting of organic and inorganic components is produced, which is already anisotropic. In the next step, the hybrid material is treated with europium vapour. As a result, it chemically converts to EuO. In this case the nanoparticles' shape is tubular. "This method is interesting because it is not limited to tubular forms. It is also possible to produce rods," explains Bastian Trepka.

Furthermore, the researchers were able to demonstrate that the [magnetic properties](#) of the semiconductor Europium(II) oxide are actually related to the shape of its nanostructure, or rather the anisotropy. After further treatment while trying to generate counter-evidence, the tubular shapes disappeared, resulting in different properties. "The experimental physicists carried out measurements that confirmed the results that had been simulated by the theoretical physicists. This enabled us to develop ideas as to how the structure brings about this particular magnetic behaviour," explains Bastian Trepka.

"What is really special about our process is the separation of structure control and chemical transformation. We can obtain different shapes from the same material by influencing the shape through process control. This way we will always get the material to assume the [shape](#) we need," says Trepka. In the case of Europium(II) oxide, this is a topotactic nanotransformation that maintains its crystalline direction: it is tubular both before and after treatment.

"An intelligent material with a variety of properties," says Bastian Trepka of Europium(II) oxide. Above all, it has a simple crystalline [structure](#). "We can explain changes in properties with appeal to the crystalline structures, which are pre-determined." This is ideal for basic research.

**More information:** Bastian Trepka et al. Nanomorphology Effects in

Semiconductors with Native Ferromagnetism: Hierarchical Europium (II) Oxide Tubes Prepared via a Topotactic Nanostructure Transition, *Advanced Materials* (2017). [DOI: 10.1002/adma.201703612](https://doi.org/10.1002/adma.201703612)

Provided by University of Konstanz

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