



# Novel nanoparticles with improved magnetic properties

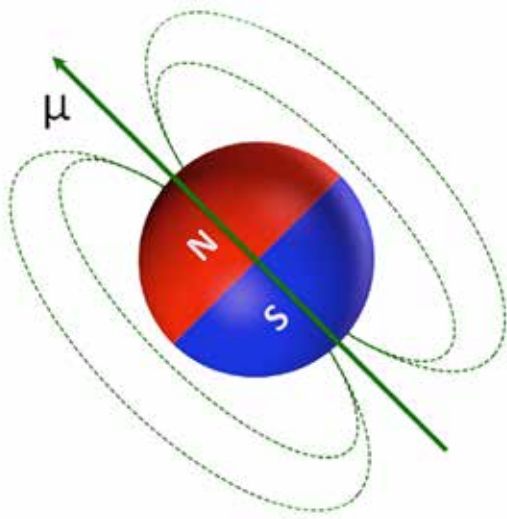
- Ultrahigh magnetic moments
- Magnetic nanoparticles
- Next-generation magnets

## Challenge

- An increase in the field strength of magnetic components in manufacturing processes and electronic devices may result in a reduction in energy consumption.
- The performance of biomedical applications such as magnetic resonance imaging and hyperthermia treatment of cancer, strictly depend on the strength of magnetic nanoparticles.
- There is a need to provide a cost-efficient method of manufacturing stronger magnets without increasing the physical size or weight of such materials.

## Solution

- At the University of Leicester, we have developed novel nanoparticles with unprecedentedly high magnetic moments, which are essential for developing future and emerging technologies with improved energy efficiencies.
- These high-moment magnetic nanoparticles have applications in biomedical science and the potential to form the building blocks of the next-generation magnets.



**Figure 1:** Illustration of a nanomagnet

## Benefits

- Commonly used bulk magnets made from single-phase materials consist of numerous small regions called magnetic domains, inside which the magnetic moments of atoms align in one direction. Different domains can have magnetic moments pointing in different directions, which dramatically reduces the overall magnetic moment. Consequently, conventional bulk magnets cannot provide a magnetic moment approaching the theoretical maximum.
- A state-of-the-art concept is to use high-moment magnetic nanoparticles as the building blocks of bulk magnets. Novel magnetic materials with much improved energy efficiency are obtained when nanoparticles are grown with magnetic moments approaching theoretical maximum and then assembled with aligned magnetization at a high packing density.

## Market

- Magnetic components are ubiquitous in electronic and electrical devices with applications extending from industry to household appliances, such as motors, power generators, wind turbines (green technology), loudspeakers and cell phones. Other possible applications include high-density data storage devices, components of quantum computers and spintronics, and biomedical applications including treatment and diagnosis.

- The market potential for the applications of magnetic materials in the energy sector is vast. The world's total electricity generation was 20.2 trillion kWh in 2010 and is projected to be 26.6 trillion kWh in 2020 [International Energy Outlook, US Energy Information Administration, DOE/EIA-0484(2013), July 2013].
- Biomedical applications of magnetic nanoparticles have attracted much attention in recent years and has a huge market potential. The global market for nanoparticles in the life sciences is estimated at over \$29.6 billion for 2014. This market is forecast to grow to more than \$79.8 billion by 2019, to register a healthy compound annual growth rate (CAGR) of 22%. [NANOTECHNOLOGY MARKET – Nanotechnology Markets in Healthcare & Medicine].

## Opportunity

Seeking co-development partners and/or a licensing opportunity to scale up the preparation high-moment magnetic nanoparticles, as well as their applications in the construction of bulk magnets and biomedical treatment/diagnosis.

## IP status

A GB priority patent application has been filed by the University of Leicester.

## Publications

Yang *et al.*, 2016 "Robust ferromagnetism of chromium nanoparticles formed in superfluid helium", *Adv. Mater.* (2016) DOI: 10.1002/adma.201604277.

### Find out more

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