High Magnetization Materials

Magnetic materials group/School of Materials Science and Engineering/UNSW

This technology is to use exchange coupling and quantum confinement effect to produce extremely high magnetization materials, which is different from traditional metal alloys or amorphous composite magnetic materials. Magnetic nanomaterials in confinement environment will show different properties from bulk materials. In this technology, we embed nanostructured magnetic materials into a magnetic reservoir. The confined nanostructures will show extremely high magnetization. Thus, high magnetization materials can be achieved. We have achieved a magnetic moment of over 10 μ_B/atom at room temperature, compared to 2.2 μ_B/Fe. Patent application is under preparation.

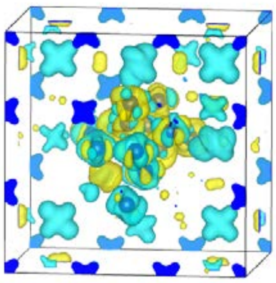

Figure 1: 15 atoms embedded in magnetic reservoir (blue and yellows indicates the spin density.

Competitive advantage

Currently magnetic materials have many applications, including microwave absorption, sensors, NFC mobile phone, wireless charging, RFID reader, transformer, magnetic recording media and motors for electric car etc. Higher magnetization can make the device smaller and more efficient. Most of the currently magnetic materials for the above applications have magnetic flux density around 1-1.6 T. It is difficult to increase the flux density due to the limitation of magnetic materials (Fe is 2.2 T and the alloy will have much lower magnetization). Our technology uses quantum confinement effect to greatly improve the magnetization. A patent application is under preparation.

Recent research projects

Current projects are the study of magnetic properties in 2D materials (for the future spintronics device having the potential to replace current semiconductor devices), the development of high magnetization materials and magnetic nanoparticles (for the bioapplications, including hyperthermia, drug delivery and magnetic resonance image). I have achieved over 4.1 M funding from different countries, including Singapore and Australia.

Successful applications

The development of high magnetization soft magnetic materials and high sensitive magnetic sensors for Singapore Defense Science and Technology Agency; the investigation of magnetic materials for MEMS applications for Sony, Japan; the development of magnetic nanoparticles as agents for hyperthermia and magnetic resonance imaging for Engino (Shanghai) Engineering Plastic Ltd and the development of high sensitive of gas sensors for Keliqiang Pty Ltd (Beijing), solving the selectivity and stability of methane and carbon monoxide gas sensors.

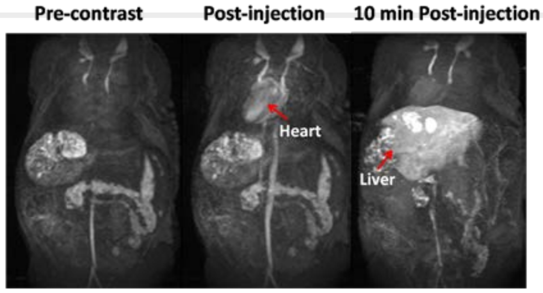

Figure 2: Magnetic nanoparticles for magnetic resonance image of a mouse. The contrast has been enhanced after the injection of magnetic nanoparticles.

More information

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