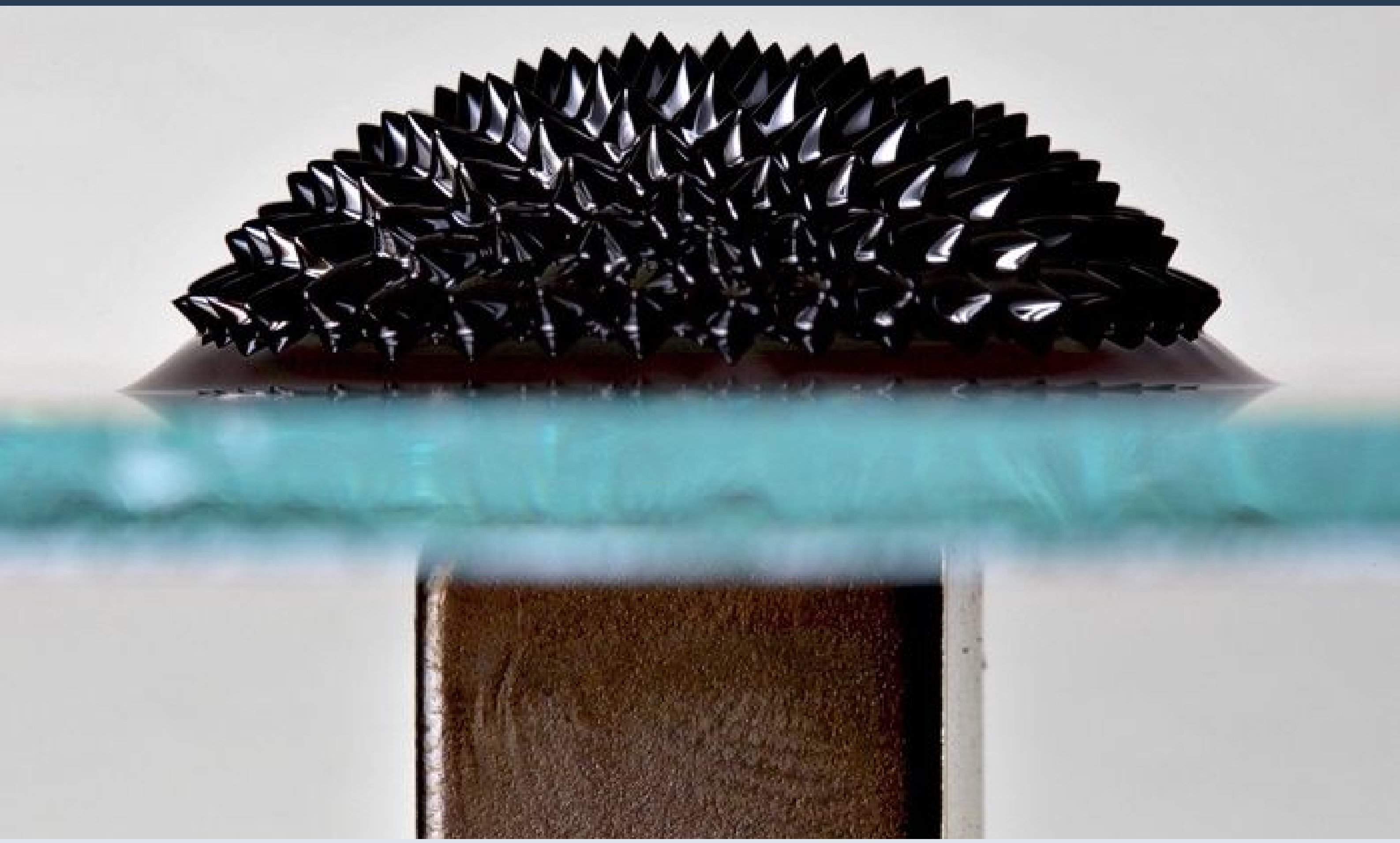
UNIVERSITY OF BIRMINGHAM

Powered by: IN-PART

Shaping NdFeB Rare Earth Magnets Using Hydrogen Ductilisation Process

A novel hydrogen ductilisation process to provide a ductile structure allowing mechanical shaping without fracturing the material.



Please note, header image is purely illustrative. Source: Gregory F. Maxwell-Wikimedia Commons-CCbySA3.0-unported

IP Status

Patent application submitted

Seeking

Development partner, Licensing

About **University of Birmingham**

At the University of Birmingham our research leads to new inventions and fuels innovation and business growth.

Tech Overview

NdFeB permanent magnets are hard and extremely brittle. To produce the final magnet shape they have to be machined and this is a time consuming, energy intensive process that produces a significant amount of material waste.

University of Birmingham researchers have developed a net-shape manufacturing technique for NdFeB magnets based on a novel hydrogen ductilisation process (HyDP) to provide a ductile structure allowing mechanical shaping without fracturing the material.

Further Details:

$Nd_2Fe_{14}B$ is a preferred phase with good magnetic properties that can only be formed by machining operations such as grinding due to its extremely hard and somewhat brittle nature. Using this new process the $Nd_2Fe_{14}B$ based intermetallic can be shaped mechanically by processes such as rolling and extrusion in a disproportionated condition. After forming, the material can be restored to its original state by the removal of the hydrogen under partial vacuum at elevated temperatures, a process that can also produce a useful degree of anisotropy.

The HyDP process has less stages and lower energy requirements than a normal rare earth magnet manufacturing route and avoids the need to use powdered rare earth materials, producing aligned magnets via a non-powder route. The HyDP process involves physically constraining rare earth alloy material and then exposing rare earth alloy to hydrogen at an elevated temperature to affect hydrogenation and disproportionation of the alloy. The disproportionated alloy is then mechanically processed followed by degassing to affect desorption and recombination of the alloy.

Constraining the alloy has been found to reduce the temperature for hydrogenation and disproportionation and hydrogenation occurs without the alloy breaking into a powder. The disproportionated alloy has improved ductility and can be mechanically processed and shaped without fracturing.

The process is particularly applicable to the production of shaped magnets and thin magnetic sheets such as those used in laminated magnets.

Benefits

- Ductile structure possible with good magnetic properties after forming.
- Allows magnet forming through processes such as pressing and extrusion.
- Allows formation of thin sections without the need for machining.
- Reduced number of pressing steps.
- Reduced energy requirement.
- Reduced material waste.

Applications

The process has the potential to be applied to all NdFeB manufacturing as it results in a lower cost manufacturing process with reductions in waste material but it is particularly applicable to applications where shaped or thin section magnets are required and new applications where such the manufacture of such magnets isn't possible or financially viable using existing processes.

Opportunity

The university has manufactured test buttons in a single NdFeB alloy system to demonstrate that the process delivers a material that can be shaped by pressing or rolling. They are looking for either a licensee to take the technology forward or funding to develop the process to a higher TRL, preferably to the point of manufacturing commercial magnet products.

ZSR925

Patents

- International patent application published as WO2017/001868