Poster | Raw materials

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[P2] Raw Materials & Recycling

Session Chair: Mr. Johann Fischbacher (University for Continuing Education Krems, Austria), Dr. Yusuke Hirayama (AIST, Japan)

[P2-27] Tailoring magnetic properties of short loop recycled NdFeB magnets via powder blending

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Electrification is projected to increase the current demand for rare earth containing permanent magnets. Of these, sintered neodymium iron boron (NdFeB) has the largest market share due to their high energy density. Rare earths including Nd, Pr, Dy and Tb, used in magnets, are considered to be highly critical by the UK, EU and US, meaning they are economically essential but also at high risk of supply shortages (1,2,3).One method to diversify the supply is to recycle magnets from different waste streams, such as hard disk drives, motors, loudspeakers, wind turbines, scientific and medical equipment. Developed at the University of Birmingham, hydrogen processing of magnetic scrap (HPMS) technology has shown to be effective at liberating alloy powder directly from the device, which can be purified and used as feedstock for sintered magnet production (4,5).
This short loop recycling approach is energy saving and less damaging to the environment when compared with other recycling methods such as hydrometallurgy. (6)One of the challenges for the short loop process is that the composition of the input material is determined by the scrap feed. Waste magnets can be segregated into different streams around fixed compositions but often the grade of magnet which is required in the new application is different to the scrap feeds which are available.
Blending recycled HPMS powders of different compositions, unlocks the ability to alter the composition of the final magnet by varying the addition of a second recycled powder or blending with virgin material. Recycled material can contain a higher level of contamination compared with virgin material, so blending recycled feedstock with virgin material can help dilute this contamination and allow for control of rare earth content, impacting magnetic properties such as coercivity. Further work at the University has also shown that it is possible to reduce these impurities prior to re-sintering (7).Different scrap sources of the following nominal compositions: A: $Nd_{(9.81)}Pr_{(2.85)}\ Dy_{(0.35)}\ Gd_{(0.77)}Fe_{(bal)}B_{(6.35)}$ and B: $Nd_{(9.19)}Dy_{(3.06)}Fe_{(bal)}Co_{(2.97)}B_{(5.9)}$, were processed in the HPMS reactor at the University of Birmingham, purified and jet milled. These micronised powders were blended in varying ratios, with small additions of neodymium hydride powder added to compensate for oxidation and the lost rare earth during jet milling. The blends were aligned compacted and sintered between 10301080°C for 2-6 hours. The resulting magnets were analysed for their composition and magnetic properties.
In conclusion magnets made from material A yielded a magnet of the properties B_r : 1.23

T, H_{cJ} : 1136 kA/m and $(BH)_{max}$:295 kJ/m^3, while material B produced B_r : 1.14 T, H_{cJ} : 2254 kA/m and $(BH)_{max}$: 256 kJ/m^3. Blending of both materials showed the ability to vary the coercivity of the finished magnet by changing the blending ratioof the powders (see Figure 1).

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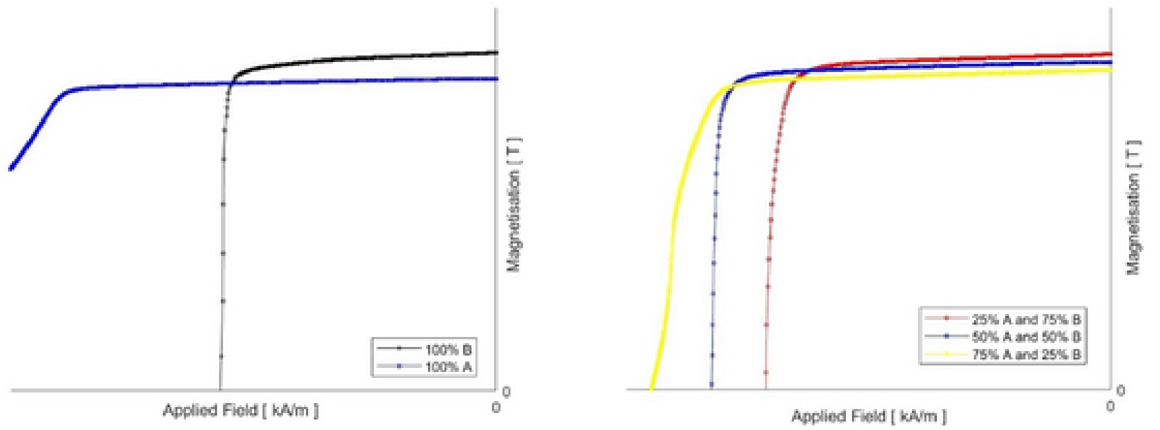

Figure 1: *Demagnetisation curves of magnets made from scrap A and B (left). Demagnetisation curves of magnets made from A and B blended in increments of 25% (right)*