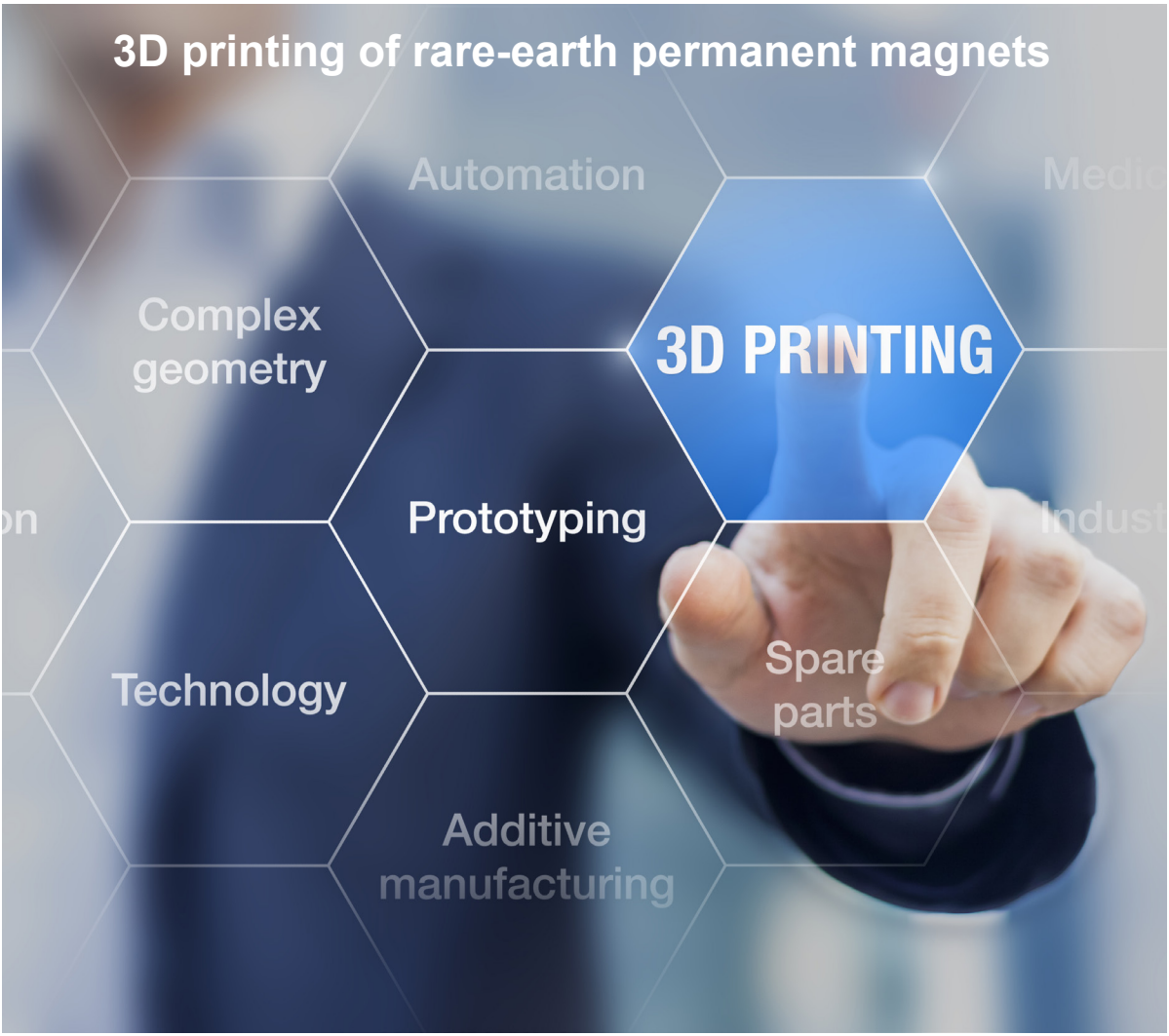
3DREMAG

3D printing of rare-earth permanent magnets



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eit RawMaterials

This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation

3DREMAG project

Need

3DREMAG project (funded by EIT Raw Materials) aims to develop and introduce to the market a 3D printable NdFeB powder. NdFeB magnets contain around 30 wt-% of Nd and Dy, both classified as critical raw materials by the EU. The developed powder enables 3D printing of optimized magnet configurations for e-drives needed in future mobility applications with reduced waste. This will be the first high performance spherical NdFeB powder in the market tailored for use in 3D printing.

Approach

NdFeB magnets are produced today by sintering to form blocks, from which the final shape is machined, or by making bonded magnets by injection molding. This generates significant waste of critical raw materials and limits design freedom. 3D printing enables near-net-shape manufacturing of complex shaped NdFeB magnets, eliminating the machining waste and enabling more efficient topologies for electrical machines. The challenge is that NdFeB powder suitable for 3D printing is not available on the market. 3DREMAG aims to change that by developing a processing route to produce NdFeB powder with spherical morphology and particle size distribution suitable for laser powder bed fusion 3D printing. In addition, the alloy composition and processing parameters are tailored to form the desired microstructure and resulting high magnetic properties after 3D printing.

Benefit

- Geometrical freedom
- Near-net shape manufacturing
- Hybrid structures
- Cost efficient small series

Project partners

- VTT (coordinator)
- CEA
- Fraunhofer IWKS
- Less Common Metals
- Siemens
- Technical University of Darmstadt
- Tekna

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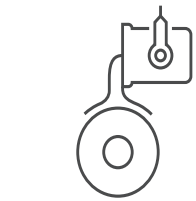
3DREMAG processing route

Strip casting

Casting the alloy on a rotating copper wheel to form a thin strip that is broken to flakes.

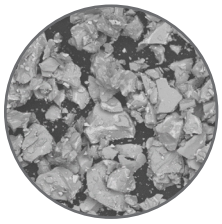


Strip cast flakes

Hydrogenation & milling

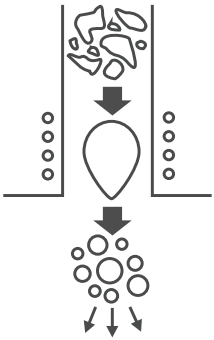
Hydrogen decrepitation makes the alloy brittle and easy to mill with gas jets into small particles.

Irregular powder

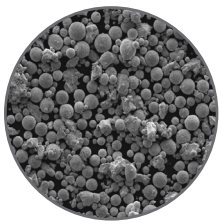


Plasma spheroidization

The jet milled, irregularly shaped particles are melted with plasma. The metal droplets experience rapid cooling and solidify into spherical particles during free fall in the reactor chamber. The resulting spherical powder has high flowability and packing density needed in laser powder bed fusion 3D printing.

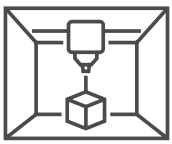


Spherical powder

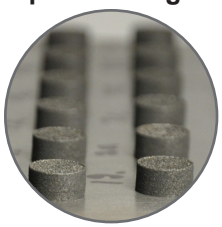


3D printing

NdFeB magnets are produced from the powder by laser powder bed fusion 3D printing. The powder is spread into thin layers and the laser selectively melts the cross-section of the geometry. The cycle is repeated until a three dimensional object is created.



3D-printed magnets



Post processing

After 3D printing, the magnets are heat treated, coated for corrosion protection and magnetized.

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3DREMAG

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SIEMENS

TEKNA

LCM less common metals

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