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FRAUNHOFER PROJECT GROUP FOR MATERIALS RECYCLING AND RESOURCE STRATEGIES IWKS

MAGNETIC MATERIALS

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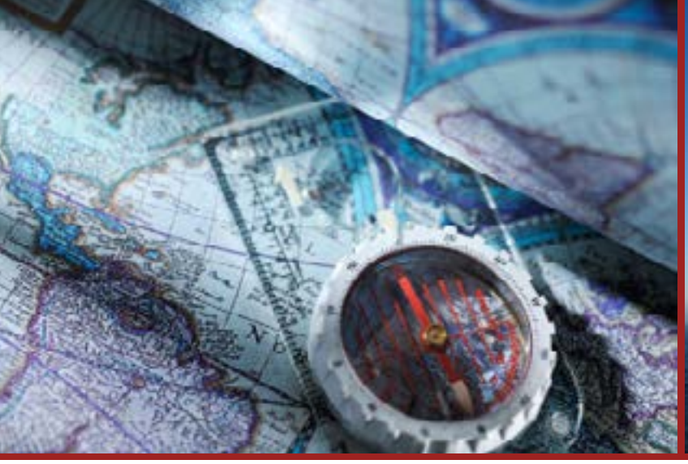


MAGNETIC MATERIALS

Magnetic materials are essential for wide-ranging industrial applications. Due to current ambitions to develop an energy as well as resource efficient society the requirements for magnetic materials concerning magnetic properties and especially energy density are increasing. For high-tech applications (smartphones, computers, etc.), applications for renewable energies (wind power generators) and electric vehicles (electric motors) high-performance magnetic materials like Nd-Fe-B are necessary. Due to their high energy product they are for the time being not substitutable by alternative magnetic materials. Rare earth elements used for the production of Nd-Fe-B magnets are therefore of great strategic importance.

To secure a sustainable supply of our industries with high performance permanent magnets and the raw materials used for their production we address the following subjects:

- Recycling technologies for End of Life-magnets and post-industrial scrap
- Substitution of critical elements (in particular rare earths)
- Resource strategies for magnetic materials

Recycling

Due to the diversity of circulating magnetic material based on Nd-Fe-B a direct re-use of magnets is not profitable for most applications. Chemical extraction of rare earths is energetically extensive but would allow the direct refeed of rare earths into the existing market. The rare earth elements used for Nd-Fe-B magnets are mainly used for this application. Less energetically extensive recycling of the whole alloy for the production of recycled magnets is therefore beneficial.
We are focusing on the following subjects:

- Development of recycling concepts for magnetic materials from waste electronic devices and post-industrial scrap
- Further development of material recycling technologies based on melting and powder metallurgical methods
- Development of biochemical processes for the recycling of valuable materials (especially rare earths) from magnetic materials
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Resource strategies

Concerning resource strategies we offer consultancy and studies for industry and politics on the following subjects:

- Recording and assessing the complex cycle of magnetic materials
- Criticality of magnetic materials and the raw materials used for their production
- Life Cycle Assessment
- Closing the cycle of magnetic materials by establishing a network of suppliers for secondary raw materials, magnet producers and end-users for recycled magnets

Substitution

To decrease the dependency on rare earth elements which are classified by the EU as critical raw materials we are searching for potential substitutes on elemental level as well as material and system level. On elemental level less critical rare earth elements are used for the production of magnets. Those elements occur in great quantities as byproducts from rare earth mining and their application in magnets would therefore contribute to the rare earth balance.
Our research topics are:

- Synthesis of permanent magnets with less critical rare earths or rare earth free alloys on a pilot production scale
- Development and production of primary alloys by melting in a vacuum induction furnace or arc melter as well as rapid quenching via strip casting and melt spinning
- Powder metallurgical processes for the production of sintered magnets, hot deformed magnets and anisotropic polymer bonded magnets
- Hydrogen based processes (HD and HDDR)
- Support for upscaling to industrial production scale

Analytics

We offer comprehensive analytics of magnetic materials including the determination of magnetic properties, optical investigation of magnetic domain structures and their behavior in a variable magnetic field. Besides analytics of magnetic properties we can offer precise measurement of chemical composition, thermal properties and nano- as well as microstructural features. With our thermo-optical measurement device we can observe and record sintering behavior (shrinkage and deformation) in situ during sintering.

- Structural and microstructural characterisation (3D-atom probe tomography, TEM, SEM, EBSD, EDS, WDS, XRD, Kerr-microscopy)
- Comprehensive magnetic characterisation in wide temperature and magnetic field ranges: 4-1200 K, magnetic fields up to 14 T (VSM, PPMS, Permeameter)
- Chemical analytics (ICP-OES, ICP-MS, µXRF, XRF, EDS, 3D- atom probe tomography)
- Thermo-optical characterisation (TOM-AC)

Are you interested in a collaboration?
We will be pleased to advise you. You may contact us by phone or e-mail. For more information, please visit our website.