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LOEWE-Focus RESPONSE (Resource-Efficient Permanent Magnets by Optimised Use of Rare Earths)

Rare-earth magnets have high energy densities and represent a key component for the electric mobility as well as in alternative energy generation methods. However, the extraction of rare earths is highly energy-intensive and causes intense pollution of the environment. In this research project, the manufacturing processes of rare-earth magnets with reduced rare-earth content and rare-earth-free permanent magnets are investigated by means of forming processes.

Project description

In cooperation with the Fraunhofer Project Group and the TU Darmstadt in its fields of materials science, chemistry, physics and engineering, two main objectives are targeted in this research project. On the one hand, the aim is to reduce or to substitute the proportion of rare earths in the strongest rare earth magnets without having significant performance losses. The second objective is to develop new magnets of the next generation without rare earths with higher energy density than conventional magnetic materials.

Results

One promising mechanical approach is to tailor the microstructure by different forming processes. For example, grain refinement, shape anisotropy and crystallographic texture can enhance magnetic properties.
For this reason, a continuous severe plastic deformation process based on Equal Channel Angular Swaging (ECAS) was developed and put into operation on a high speed press. This process enables a continuous production of nanocrystalline isotropic FeCo-samples with an increased coercive field strength. The induction of a shape anisotropy and crystallographic texture is realized by a rotary swaging process. Samples processed by rotary swaging show shape anisotropy and texture in forming direction with higher coercive field strength in comparison to grain refined samples. A process chain of ECAS and a subsequent rotary swaging process demonstrates that both grain refinement and anisotropy effects can be superimposed.

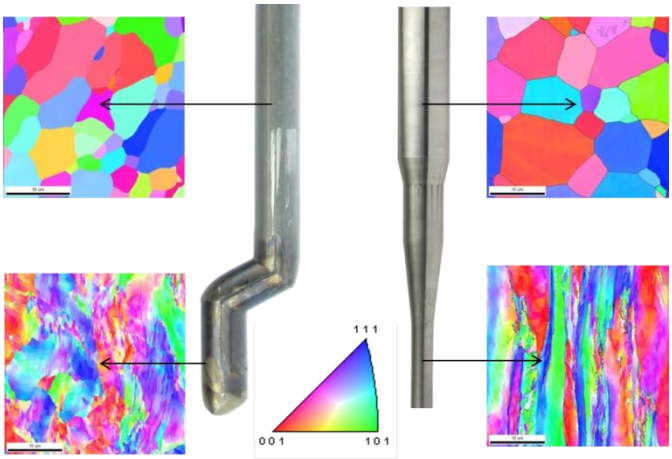

Figure 1: Left: grain refinement by Equal-Channel-Angular-Swaging process; right: anisotropy achieved by rotary swaging in a FeCo alloy

Acknowledgement

The results of this reseach project are achieved in the framework of by funding programme Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz (LOEWE) of Land Hessen funded project "(RESPONSE) Resource-Efficient Permanent Magnets by Optimised Use of Rare Earths".

Project Information

Funding period	Jan. 2014 – Dez. 2017
Research assistant	M.Sc. Lennart Wießner
Department	Process chains and forming units

Sponsor

LOEWE
Exzellente Forschung für Hessens Zukunft