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Title: Development of a Rotary Swaging Production Route for Nd-Fe-B Permanent Magnets

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Abstract: (1500 Characters)

High performance Nd-Fe-B permanent magnets are essential for future applications such as e-mobility and solid state cooling based on the magnetocaloric effect. The monotonous increase of demand during the last years documents the importance of this material. More than 90% of the production is covered by a powder-metallurgical sintering route, which provides highest remanence, anisoptropy and coercive field values. This energy intense route has also the disadvantages of production wastes during shaping and the complex process handling with very fine metal powders. As an alternative route for near-net-shaped Nd-Fe-B permanent magnets we want to introduce the method of rotary swaging [1]. Cast Nd-Fe-B alloys are fed into a steel cladding and deformed by a rotary swaging process. Correlated with the observed grain size reduction, the rotary swaged Nd-Fe-B samples are successfully magnetically hardened. However, the control of the fracture of the grains still requires improvement in terms of a more homogeneous grain size distribution. In general, the rotary swaging process enables a continuous manufacturing of Nd-Fe-B permanent magnets directly from castings, which has the potential to be more productive and thus cost-effective in comparison with the conventional routes. In addition, there is potential to use less critical rare earth metals like Ce and La to substitute parts of Nd due to a controlled microstructural design by the rotary swaging.

References:

[1] F. Chi et al., Towards manufacturing of Nd-Fe-B magnets by continuous rotary swaging of cast alloy, J. of Magnetism and Magnetic Materials 490, 165405 (2019).