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Hysteresis Design of Magnetic Materials for Efficient Energy Conversion

Tuesday, 01 Dec. 2020, 9:00 s.t., UDE, Zoom

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Zoom information
Meeting-ID: 845 3221 2224
Kenncode: 250973

From inverse magnetic design to additive manufactured soft and hard magnets

Within this talk a compilation of different additive manufacturing methods will be given with special focus on (i) fused deposition modeling (FDM) and (ii) selective laser melting (SLM) for additive manufacturing of magnets [1,2]. I will present that it is possible to produce NdFeB polymer bonded magnets with gradual change in magnetic properties, which is not possible to realize with any other method [3]. Furthermore, first results on the alignment of magnetic particles during printing will be shown allowing to increase the remanance of printed magnets. Furthermore, I will present results of magnetic soft materials capable of transforming between three-dimensional (3D) shapes in response to magnetic stimuli [4].

In order to fully make use of these new production flexibility advanced algorithm are required to determine the shape of the printed structure such as mechanical parts or magnets to meet the requirements for applications I will introduce an inverse field method [5]. As an example I will present the fabrication of additive manufactured magnetic shimming elements to improve the homogeneity of a magnetic field. The simulation algorithm can find a suitable permanent and nonlinear soft magnetic design that fulfills the desired field properties. I will conclude with an outlook how 3d printing may influence the design of functional materials and applications in the future.

[1] C. Huber et al., “3D print of polymer bonded rare-earth magnets, and 3D magnetic field scanning with an end-user 3D printer,” Appl. Phys. Lett., vol. 109, no. 16, p. 162401, Oct. 2016.

[2] Li, Ling, et al. "Additive manufacturing of near-net-shape bonded magnets: Prospects and challenges." Scripta Materialia vol 135 , p. 100-104, 2017.

[3] C. Huber et al., “3D Printing of Polymer-Bonded Rare-Earth Magnets With a Variable Magnetic Compound Fraction for a Predefined Stray Field,” Sci. Rep., vol. 7, no. 1, p. 9419, Aug. 2017.

[4] Kim, Yoonho, et al. "Printing ferromagnetic domains for untethered fast-transforming soft materials." Nature vol. 558. pp. 274, 2018

[5] F. Bruckner et al., “Solving Large-Scale Inverse Magnetostatic Problems using the Adjoint Method,” Sci. Rep., vol. 7, p. 40816, Jan. 2017.