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Presentation Title

Magnetic materials in sustainable energy

Abstract

A new energy paradigm, consisting of greater reliance on renewable energy sources and increased concern for energy efficiency in the total energy lifecycle, has accelerated research in energy-related technologies. Due to their ubiquity, magnetic materials play an important role in improving the efficiency and performance of devices in electric power generation, conversion and transportation.

Magnetic materials are essential components of energy applications (i.e. motors, generators, transformers, actuators, etc.) and improvements in magnetic materials will have significant impact in this area, on par with many “hot” energy materials efforts (e.g. hydrogen storage, batteries, thermoelectrics, etc.). Their increased implementation in these devices and related market growth of e.g. electric vehicles and wind turbines will depend critically on the price and stable availability of the rare earth metals.

State-of-the-art hard and soft magnets and magnetocaloric materials with an emphasis on their resource-efficient optimization for energy applications will be described. More specifically, the impact of hard magnets on electric motor and transportation technologies, of soft magnetic materials on electricity generation and conversion technologies, and of magnetocaloric materials for refrigeration technologies, will be discussed.

The synthesis, characterization, and property evaluation of the materials, with an emphasis on structure-property relationships, will be examined in the context of already existing and future bottle-necks in raw materials and in the supply chain.

Finally, options for recycling of rare-earth permanent magnets will be analyzed.

O. Gutfleisch, J.P. Liu, M. Willard, E. Brück, C. Chen, S.G. Shankar, Magnetic Materials and Devices for the 21st Century: Stronger, Lighter, and More Energy Efficient (review), Adv. Mat. 23 (2011) 821-842.