

Magnetic materials in sustainable energy

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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.).

The lecture focuses on the state-of-the-art hard and soft magnets and magnetocaloric materials with an emphasis on their optimization for energy applications. 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 their respective markets as well as their potential impact on energy efficiency.

Finally, considering future bottle-necks in raw materials and in the supply chain, options for recycling of rare-earth metals will be analysed.

[1] 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.*, in press.