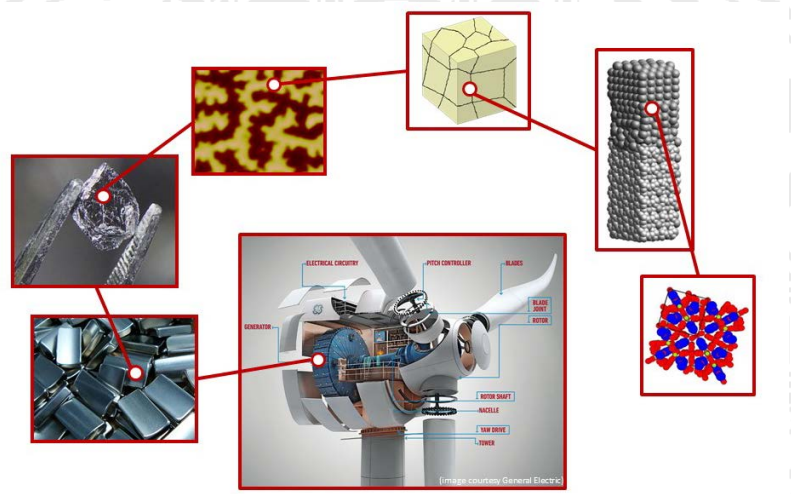
PHYSIKALISCHES KOLLOQUIUM

AM 20. NOVEMBER 2017 UM 17 UHR C.T.

IM GROßEN HÖRSAAL



MAGNETS AS ENABLERS FOR RENEWABLE ENERGY AND RESOURCE EFFICIENCY

PROF. DR. OLIVER GUTFLEISCH

INSTITUT FÜR MATERIALWISSENSCHAFT, TU DARMSTADT

Magnetic materials are key components in energy technologies, robotics, sensors and information technology. Magnets are inseparable from our everyday life. “Green” energy technologies such as wind turbines, electro-mobility and solid state cooling, rely on high performance magnetic materials which have to be available in bulk quantities, at low-cost and with tailored magnetic hysteresis.

The realisation of renewable energy technologies is generally linked to the sustainable availability of strategic metals such as the group of rare earth elements (REE) namely Nd, Gd, Tb, Dy, transition metals such as Co, Ga, Ge, In, and the platinum group metals. Resource criticality is understood here as a concept to assess potentials and risks in using raw materials and their functionality in emerging technologies. The concept of criticality of strategic metals is explained here by looking at demand, sustainability and the reality of alternatives of rare earth elements.

There is an ever-growing demand for the benchmark high performance Nd-Fe-B magnets. The key question will be whether Nd-Fe-B needs to be and could be substituted. The expected increase in e-mobility and wind energy and other smart magnet usages in the future has yet to have its impact on the rare earth market. No substitute is at hand for the massive amounts of high-energy density magnets needed; yet various concept of heavy rare earth free, free rare earth and rare earth free magnets are being explored.

Gas-vapour compression technology for refrigeration, heating, ventilation, and air-conditioning has remained unchallenged for more than 150 years. There is a huge demand for a smarter, more flexible and more efficient cooling technology. Magnetic refrigeration could be that alternative working without gas-based refrigerants. Energy spent for domestic cooling is expected to outreach that for heating worldwide over the course of the twenty-first century.

I will address these different global trends and will attempt to scale bridge these challenges by discussing the modelling, synthesis, characterization, and property evaluation of novel magnetic materials considering their micromagnetic length scales, phase transition characteristics and hysteretic properties.