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Hysteresis Design of Magnetic Materials for Efficient Energy Conversion

Tuesday, 09 Feb. 2021, 9:00 s.t., TU Darmstadt, Zoom

Prof. Dr. Björgvin Hjörvarsson

Department of Physics and Astronomy

Uppsala University, Sweden

The use of configuration and confinement to tailor amorphous magnetic materials

Abstract:

Amorphous materials can be designed to have uniaxial or biaxial anisotropy [1]. The obtained anisotropy cannot be associated to a crystal structure in amorphous materials. Furthermore, the ordering temperature of amorphous materials can be tailored by both composition and extension of the material, as can the spatial dimensionality of their magnetic phase transitions [2]. Their magnetic properties can also be influenced by changes in strain state [3] and gigantic proximity effects have been observed in amorphous materials [4]. Amorphous materials offer therefore a wide range of possibilities, when striving for given functionality using structured magnetic materials. Although many of their properties are well understood, there are still aspect of the magnetic properties of amorphous materials which elude us. The main focus of the talk will be on how magnetic properties of amorphous materials can be understood and used. The relation between the intrinsic distribution of the elements and the obtained magnetic properties [5] will be discussed and how these can be used to obtain unique magnetic properties.

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[2] 2D XY-like amorphous Co68Fe24Zr8/Al70Zr30 multilayers, M. Ahlberg, G. Andersson, and B. Hjörvarsson, Phys. Rev. B 83, 224404 (2011), Experimental realization of amorphous 2D XY magnets, A. Liebig, P. T. Korelis, M. Ahlberg and B. Hjörvarsson, Phys. Rev. B 83, 224404 (2011)

[3] Strain enhanced magnetic anisotropy in SmCo/BaTiO3 multiferroic heterostructures, R. Moubah, F. Magnus, B. Hjörvarsson, and G. Andersson, J. Appl. Phys. 115, 053905 (2014); http://dx.doi.org/10.1063/1.4863819, Magnetostrictive properties of amorphous SmCo thin films with imprinted anisotropy F. Magnus, R. Moubah, V. Kapaklis, G. Andersson, and B. Hjörvarsson, Phys. Rev. B 89, 134414

[4] Magnetic leverage effects in amorphous SmCo/CoAlZr heterostructures, R.A. Procter, F. Magnus, G. Andersson, C. Sanchez-Hanke, B. Hjorvarsson, and T.P.A. Hase, Applied Physics Letters, Volume: 107 Issue: 6 Pages: 062403 (4 pp.) Published: 10 Aug. 2015 , Long-range magnetic interactions and proximity effects in an amorphous exchange-spring magnet, F. Magnus, M. Brooks-Bartlett, R. Moubah, R. Procter, G. Andersson, T. Hase, S. Banks, and B. Hjörvarsson, Nature Communications 7, Article number: ncomms11931 doi:10.1038/ncomms11931

[5] The impact of nanoscale compositional variation on the properties of amorphous alloys. G. Ryota; M. Baben to; A. Pundt; V. Kapaklis; B. Hjörvarsson. Scientific Reports (Nature Publisher Group); London Vol. 10, Iss. 1, (2020). DOI:10.1038/s41598-020-67495-4

About the speaker:

The group that I am heading at Uppsala University has build up a significant competence and instrumentation within the fields of materials production and analysis. This includes state of the art growth systems such as MBE and UHV-sputtering. Since 2016, Additive Manufacturing (AM) is also part of our core activity, in collaboration with department of chemistry and technology at Uppsala University. I am also responsible for the operation of Super ADAM at ILL, which is a Swedish national facility on neutron reflectivity. The main emphasis of the research activity is on the properties of single crystal and amorphous materials and artificial heterostructures, as well as meta-magnetic properties of patterned structures such as artificial spin ice. The activity is heavily biased towards finite size effects on structural and magnetic ordering as well as the use of combined energy and length scales to obtain novel material properties (metamaterials). Furthermore, energy related issues such as hydrogen in matter are enforced. The activity is heavily based on national and international collaborations within experimental, as well as theoretical physics and engineering sciences.