SEMINAR

December 16 (Tue) 2025, 15:00 ~ 16:00

IMR, International Center of Educational Research, Seminar Room 1

(金属材料研究所 国際教育研究棟セミナー室 1)

Prof. Del Atkinson

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Rare Earth-Transition Metal Ferrimagnetic Thin-Films For Spintronics: Mapping Magnetization and Compositional Gradients

Rare Earth–Transition Metal (RE:TM) ferrimagnetic alloys have been of scientific and technological interest for around fifty years, most recently for applications in spintronics. These alloys consist of antiferromagnetically coupled sublattices, with distinct magnetizations that depend on the temperature and the composition, resulting in the occurrence of compensation points, where either the net magnetization or angular momentum are minimised. Typically, spintronic RE:TM alloys thin-films have PMA and an amorphous structure with the RE component around the 22-24 at% level, the onset of the amorphous state is briefly considered for RE:TM compositions [1]. The distribution of atomic species within these sublattices plays a role in determining the electronic structure of the alloy and the properties at the interfaces that influence the perpendicular magnetic anisotropy (PMA), proximity-induced magnetization (PIM), compensation points, and spin transport. PIM has been linked to the efficiency of interfacial spin transport [2, 3], so the PIM in Pt interfaced with RE:TM alloys is also discussed [4]. While RE:TM systems are assumed to be compositionally uniform, recent investigations reveal spatial variations in the elemental distribution that have important implications for spintronics. Here the uniformity of the composition and the associated magnetic behaviour are discussed and it is shown that uniformity through the 'bulk' of a thin-film alloy should not be assumed [5], as these compositional variations affect the magnetization, compensation temperatures, PMA and potentially the spin transport. More recently, researchers have demonstrated that deliberately designed RE:TM compositional gradients can result in field-free SOT switching, where it was assumed the gradient drives a transition from in-plane to out-of-plane magnetization. Here magnetization profiles of the RE component and the total magnetisation were mapped by resonant x-ray and neutron reflectivity analysis through the thickness of compositionally graded RE:TM thin-films to determine the in-plane and PMA regions [6].

[1] O Inyang et al., D Atkinson Scientific Reports **10 (1)**, 9767 (2020)

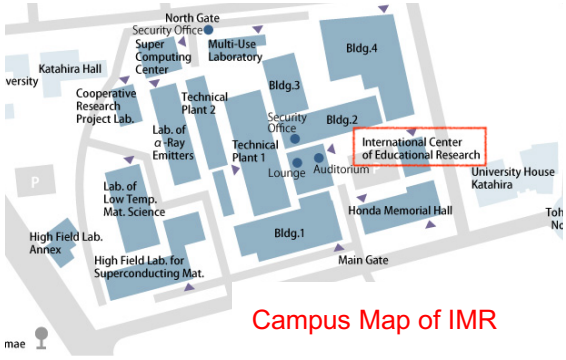
[2] C. Swindells et al., D. Atkinson Appl. Phys. Letts. **119**, 152401 (2021)

[3] C. Swindells et al., D. Atkinson Phys Rev B **105**, 094433 (2022)

[4] C Swindells, et al., D Atkinson Phys Rev Res **2 (3)**, 033280 (2020)

[5] O Inyang, et al., D. Atkinson Appl. Phys. Letts. **123 (12)** (2023)

[6] D Rianto et al., D. Atkinson Communications Materials in press (2025)



Campus Map of IMR

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