Spintronic Multilayers for Energy Efficient Electronic Memory Applications

Professor Del Atkinson

This ICC Visiting Professorship at IMR, Tohoku University (Nov 2025–Jan 2026) advanced experimental research on spintronic multilayers for energy-efficient memory. Studies focused on ferromagnetic damping in CuO-based systems, revealing promising spin–orbit effects. Outcomes include ongoing collaboration, invited seminars, and a manuscript in preparation.

The primary scientific objective of the visit was to explore the materials physics underpinning applications for more energy efficient switching in spintronic/orbitronic memory technologies. A central component of the research involved experimental investigations of ferromagnetic damping in multilayer heterostructures incorporating CuO-based systems. These systems are of particular interest due to their potential to host enhanced spin–orbit and orbitronic effects, offering new pathways to manipulate angular momentum transfer with reduced power consumption.

Working closely with **Professor Seki** and collaborators at IMR, I contributed to the fabrication, measurement, and analysis of thin-film multilayers designed to probe interfacial spin transport and damping in Pt/Co/CuCuO_x. Ferromagnetic resonance techniques, FMR and ST-FMR, were employed to quantify damping parameters and to assess how CuO_x incorporation modifies damping. This could be linked to spin relaxation or orbital currents and spin–orbit coupling effects. The results obtained during the visit indicate promising trends toward tuneable damping and enhanced interfacial phenomena that could enable more energy-efficient spintronic device operation, see fig. 1. This research collaboration remains ongoing, with further experiments undertaken at IMR and analysis continuing beyond the visit. A joint manuscript is currently in development**.**

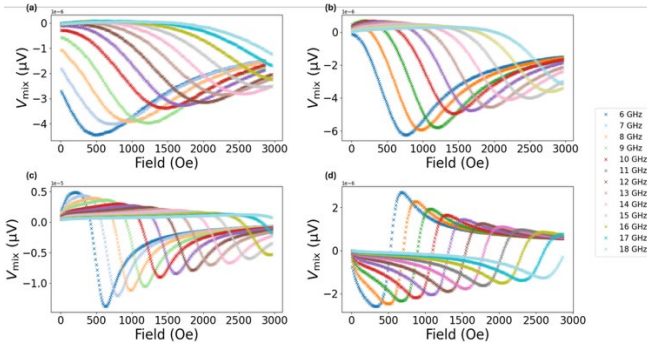

Fig 1. Spin-torque ferromagnetic resonance (ST-FMR) spectra for Pt(8 nm)|Co(3 nm)|Cu(x nm) films, for (a) x = 4, (b) x= 5, (c) x = 7, and (d) x = 10, for frequencies from 6 - 18 GHz.

In addition to experimental research, the ICC Visiting Professorship strongly supported scientific exchange and dissemination activities. I delivered a research seminar at IMR in December 2025, see fig. 2, presenting my recent work on rare-earth: transition metal alloy thin films for spintronics. I also gave invited research seminars at the National Institute for Materials Science (NIMS) in Tsukuba in January 2026 and at Kyushu University later in January 2026**.** In all external seminars, academic engagements and on LinkedIn, it was clearly stated that my visit and activities were supported by the ICC Visiting Professorship at IMR, Tohoku University.

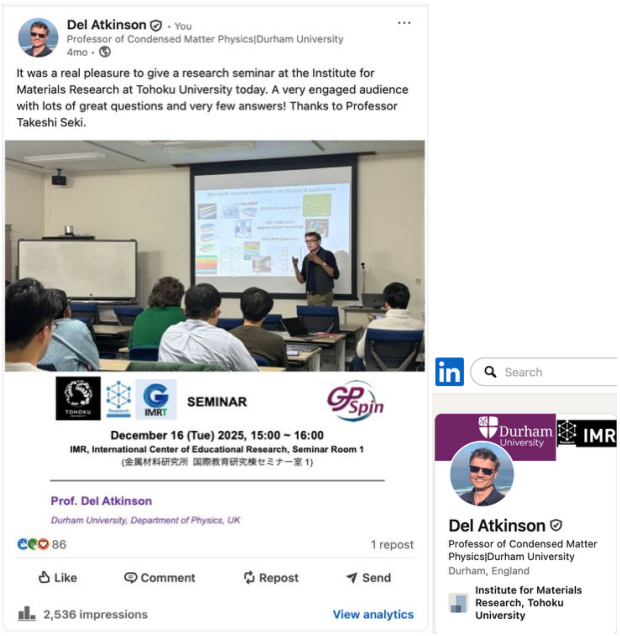

Fig2. Photo of Research Seminar at IMR posted on LinkedIn

Overall, the ICC Visiting Professorship enabled a highly productive period of experimental research, international collaboration, and academic exchange, contributing meaningfully to the development of next-generation energy-efficient spintronic memory technologies.

References

A Hodgkiss, V Kushwaha, H Suzuki, S Sakamoto, T Seki & D Atkinson - In preparation

Keywords: Magnetic properties, Spintronics, Sputtering, Spin current
Institute for Materials Research, Tohoku University,
Group of Professor Takeshi SEKI (takeshi.seki@tohoku.ac.jp)