ACCMS-Global Research Center, SRMIST, Chennai India

Webinar #33

Speaker: Dr. Satadeep Bhattacharjee

Indo Korea Science and Technology Center, Bangalore, India

Title: First-Principles Insights into Magnetic Switching: From Gilbert Damping to Spin–Orbit Torque and Beyond

Zoom link:
Lhttps://zoom.us/j/5930040801?pwd=dUUxWHNRdTlsTkttbGNHeVNWcHJIUT09

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Short biography

Dr. Satadeep Bhattacharjee is Head of Research and Development at the Indo-Korea Science and Technology Center in Bangalore, India. He received his Ph.D. from the University of Madras while working as a research fellow at the Indira Gandhi Center for Atomic Research (IGCAR), India. He worked as a postdoctoral researcher at the University of Bonn in Germany and the University of Liège in Belgium. He then worked as a researcher at Uppsala University, Sweden and University Arkansas, USA. His research interests encompass a broad aspect of materials theory that includes magnetic materials, spintronics, the role of magnetism in heterogeneous catalysis, electron transport in compound semiconductors, and the development of machine learning models for functional materials. He is also interested in code development and contributes to open-source codes.

Abstract

The field of Spintronics is anticipated to maintain a significant presence in upcoming technological advancements, particularly by advancing magnetic random access memories (MRAM) and their corresponding switching mechanisms. Theoretically, magnetic switching is governed by the Landau-Lifshitz-Gilbert (LLG) equations, which have various formulations: the standard version for magnetic field-induced switching, variations for current-induced switching or spin torques (Spin Transfer Torque (STT) or Spin-Orbit Torque (SOT)), and another for inertial switching used in laser pulse-induced or all-optical switching. This presentation will explore magnetic switching from two perspectives. The first part focuses on calculating the Gilbert damping and moment of inertia tensors using first-principles approaches. The Gilbert damping tensor is integral to the LLG equation for all switching mechanisms, while the inertia tensor is particularly relevant for laser-induced switching. A first-principles approach using the *Wannier90* formalism to calculate these tensors will be presented. The second part highlights a first-principles study of spin–orbit torque in strained orthorhombic Tin Selenide (o-SnSe), demonstrating its high intrinsic spin Hall conductivity and efficient charge-to-spin conversion properties that make it a strong candidate for next-generation SOT-based MRAM. Finally, a theoretical framework is proposed to explain the unexpectedly low effective damping in LSMO/Pt bilayers, despite Pt usually acting as a strong spin sink [5]. The interplay between spin diffusion length and a reduced spin Hall angle in LSMO/Pt is analyzed in comparison to Co/Pt, offering insights into the design of heterostructures with tunable spin transport and damping properties.

Panelist

Prof. G. P. Das

Convenerr:
Prof. Yoshiyuki Kawazoe
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