



3rd ICQMT 2025

3rd International Conference on Quantum Materials and Technologies

Spin-based Nonvolatile Memories, Unconventional Computing, and Energy Harvesting



**National University of Singapore,
Singapore
Hyunsoo Yang**

- Honors and Prizes:
- 1/2025 IEEE Fellow.
 - 1/2025 Mid-Career Award of the IEEE Magnetics Society.
 - 11/2020 Minister of Science ICT award, Korea.
 - 11/2019 National Research Foundation Investigatorship.
 - 9/2018 IEEE Magnetics Society Distinguished Lecturers for 2019.
 - 8/2014 National Research Foundation Competitive Research Programme.
 - 3/2006 American Physical Society (GMAG) Outstanding Dissertation Award for 2006.
 - 11/2005 Fellowship in the Conference on Magnetism and Magnetic Materials.
 - 9/2005 IBM Almaden-Stanford Studentship, IBM Almaden research center, California.
 - 9/2001 Patent Award, C&S Technology Inc., Seoul, Korea.
 - 9/2000 Study abroad scholarship from Ministry of Information & Communication, Korea.

**Date and Time:
From 26 April to
3 May 2025, exact
day&time will be
announced later.**

**Lecture Room:
TBD**

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Research Interest:
Spintronics, magnetic memory and sensor
Topological spin-devices, THz devices and systems
Spin based quantum devices, superconducting junctions

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10th ICSM 2025

10th International Conference on Superconductivity and Magnetism

Biography

Experience:

7/2019 – Present Professor in the Department of Electrical and Computer Engineering of National University of Singapore

4/2015 – 3/2021 GlobalFoundries (Associate) Chaired Professor in the Department of Electrical and Computer Engineering of National University of Singapore

1/2014 – 6/2019 Associate Professor in the Department of Electrical and Computer Engineering of National University of Singapore (tenured)

8/2007 – 12/2013 Assistant Professor in the Department of Electrical and Computer Engineering of National University of Singapore

3/2004 – 7/2007 Scientist in the IBM-Stanford Spintronic Science and Applications Center (Stuart Parkin's group at the IBM Almaden Research Center).

1/2002 – 3/2004 Research Assistant (James Harris's group)

3/1998 – 9/2001 Staff Engineer, C&S Technology Inc., Seoul, Korea.

MPEG4 chip design, development of video phone board and system.

Publication list (Citations of 16678; h-index of 68)

[Google Scholar](#)

258 journal publications, 220 invited talks, 22 patents (18 US patent issued)

Editorial Appointments:

Associate Editor, APEX/JJAP (2022–2025)

Editorial Board Member, SPIN (2020–2025)

Advisory Board Member, Journal of Magnetism and Magnetic Materials (2017–2020)

Editorial Board Member, Nano Convergence, Springer (2015–2020)

Editorial Board Member, Scientific Reports, Springer Nature (2015–2021)

Associate Editor, IEEE Transactions on Magnetics Conference (2016–2021)

Special topic editor on Photon-Based Experimental Techniques in Magnetism, Journal of Applied Physics (2021)

Abstract

Spin-based magnetic random-access memory is emerging as a key enabling low-power technologies, which have already spread over markets from embedded memories to the Internet of Things. In addition, spin devices can offer alternative solutions for unconventional computing and energy harvesting. We present an experimental Ising computer based on magnetic tunnel junctions, which successfully solves a 70-city travelling salesman problem (4761-node Ising problem) [1]. We also propose a spintronic artificial neuron based on the heavy metal (HM)/ferromagnet (FM)/antiferromagnet (AFM) [2], which can reset itself due to the exchange bias. Using our proposed neuron, we further implement a restricted Boltzmann machine (RBM) and stochastic integration multilayer perceptron (SI-MLP). By integrating the electrically connected eight spin-torque oscillators (STOs), we demonstrate the battery-free energy-harvesting system by utilizing the wireless RF energy to power electronic devices such as LEDs [3,4].

We present our perspective on spin device applications using emerging 2D materials [5]. Previous proposals for field-free spin-orbit torque (SOT) switching of perpendicular magnetic anisotropy (PMA) require an additional magnetic field. Exploiting the out-of-plane spins could be a solution to this challenge [6]. Here we experimentally demonstrate field-free switching of PMA CoFeB at room temperature utilizing out-of-plane spins from Weyl semimetals, TaIrTe₄ [7] and PtTe₂/WTe₂ [8]. Finally, we discuss magnon-mediated spin torques, which could minimize Joule heating and corresponding energy dissipation [9]. We demonstrate magnon current-driven switching of PMA at room temperature and field-free operation [10].

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