NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

EMERGING MEMORY AND COMPUTING SEMINAR SERIES

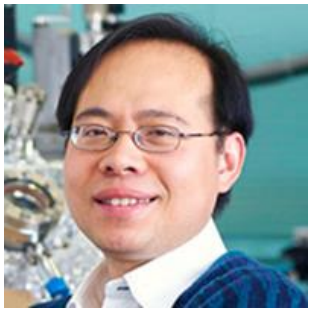
Topological Materials with Giant Spin Hall Effect and Their Applications to Magnetic Memories

Prof. Pham Nam Hai

Tokyo Institute of Technology

Date: Thursday, 1 Sep 2022
Time: 3PM (GMT +8)
Host: Prof. Lew Wen Siang

Zoom Registration Required



zoom

Abstract

Novel spin related phenomena originating from topological electronic states in topological materials, such as topological insulator (TIs), have become a very exciting topic in spintronics. In this seminar, we will review our studies on various giant spin Hall-related phenomena in BiSb topological insulator / ferromagnet heterostructures, which not only provide new insights into the spin physics in TIs but also open the pathway to novel spintronic devices. Here, BiSb is a narrow-gap topological insulator with multi surface states and high carrier mobility, thus it has high electrical conductivity which is necessary for spintronic applications [1]. We found that BiSb can generate a large spin current for ultralow power spin-orbit torque switching in both epitaxial [2] and non-epitaxial BiSb/ferromagnet heterostructures [3-5]. We also found a large interfacial Dzyaloshinskii–Moriya interaction and ground-state skyrmions in BiSb/MnGa bilayers even at room temperature [6]. Furthermore, we observed a giant unidirectional spin Hall magnetoresistance effect up to 1.1 % in a BiSb/GaMnAs bilayer [7]. Those giant phenomena can be utilized to significantly improve the performance of spin-orbit torque magnetoresistive random access memory and racetrack memory [8,9].

Biography

Pham Nam Hai is an associate professor at Tokyo Institute of Technology with expertise in spintronics. His research interests include ferromagnetic nanoclusters, ferromagnetic semiconductors, ferromagnet/semiconductor hybrid systems, topological insulators, and their applications to spintronic devices including magnetic sensors, spin-based transistors, SOT-MRAM, and skyrmions. His group developed one of the most efficient spin current source using BiSb topological insulator for SOT-MRAM application. He is currently a research director for the Japan Science and Technology – CREST research program “Spin-orbit-torque magnetic memories utilizing topological surface states”, and a visiting associate professor at Center for Spintronics Research Network (CSRN), the University of Tokyo. He received the SSDM Young Researcher Award (‘09), the Ando Memorial Award (‘14), the Marubun Research Award (‘17), the German Innovation Award (Gottfried Wagener Prize) (‘19), and the MSJ Outstanding Research Award (‘20).

[1] Y. Ueda, N. H. D. Khang, K. Yao, and P. N. Hai, Appl. Phys. Lett. 110, 062401 (2017).
[2] N. H. D. Khang, Y. Ueda, P. N. Hai, Nature Mat. 17, 808 (2018).
[3] N. H. D. Khang, S. Nakano, T. Shirokura, Y. Miyamoto, P. N. Hai, Sci. Rep. 10, 12185 (2020).
[4] T. Fan, N. H. D. Khang, T. Shirokura, H. H. Huy, P. N. Hai, Appl. Phys. Lett. 119, 082403 (2021).
[5] T. Fan, N. H. D. Khang, S. Nakano, P. N. Hai, Sci. Rep. 12, 2998 (2022).
[6] N. H. D. Khang, T. Fan, and P. N. Hai, AIP Adv. 9, 125309 (2019).
[7] N. H. D. Khang and P. N. Hai, J. Appl. Phys. 126, 233903 (2019).
[8] H. Wu et al., Nature Commun. 12, 6251 (2021).
[9] N. H. D. Khang et al., Appl. Phys. Lett. 120, 152401 (2022).