2023 Taiwan－AVS Symposium: Spintronics for Sustainable Development Goals

2023 Taiwan－AVS Symposium: Spintronics for Sustainable Development Goals will be held at the Department of Physics, National Cheng Kung University, Tainan, Taiwan on the 17, January 2023. This series of symposia started originally as a workshop on recent advances in the study of spintronics for energy-efficient data storage and energy harvesting. The symposium has become an annual tradition and an important meeting to promote communications and collaborations for advancing research activities in the field of spintronics.

Organizers:

The Physics Society of Taiwan, Taiwan
American Vacuum Society (AVS)-Taiwan Chapter, USA

Hosted by:

National Pingtung University, Taiwan
National Cheng Kung University, Taiwan

Sponsors:

National Science and Technology Council, Taiwan

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Chun-Rong Lin (Professor, National Pingtung University, Taiwan)

Tzu-Fang Hsu (Associate Professor, National Pingtung University, Taiwan)

Programs

Spintronics for Sustainable Development Goals Tuesday, January 17, 2023 Classroom 35X01 (B1F), Physics & Chemistry Bldg. ***Chair: Prof. Hua-Shu Hsu*** *National Pingtung University, Taiwan*	
Time	**Session**
08:00 - 08:45	**Registration**
08:45 - 09:00	**Opening Speech**
09:00 - 09:30	**All Optical Magnetization Manipulation** *Prof. Stéphane Mangin, Université de Lorraine (UL), Nancy (France)* Social Links: https://spin.ijl.cnrs.fr
09:30 - 10:00	**A spin-orbit torque device toward energy-efficient neuromorphic Spintronics** *Prof. Chin Huang Lai (賴志煌), National Tsing Hua University, Hsinchu (Taiwan)* Social Links: https://nthulab426.wixsite.com/chlailab416
10:00 - 10:30	**Magnetic semiconductor rare earth nitrides – spintronic materials for energy-efficient cryogenic computing memories** *Dr. Simon Granville, Victoria University of Wellington, Wellington (New Zealand)* Social Links: https://people.wgtn.ac.nz/simon.granville/about
Coffee break	
10:50 - 11:20	**Building Efficient Spin-Orbit MRAMs with Orbital Hall Materials** *Prof. Chi-Feng Pai (白奇峰), Taiwan Semiconductor Manufacturing Company, Hsinchu (Taiwan)* Social Links: http://www.mse.ntu.edu.tw/~cfpai/index.html
11:20 - 11:50	**Manipulating spin-polarized electrons of electrocatalyst and photocatalyst for energy conversion** *Prof. Chun-Wei Chen (陳俊維), National Taiwan University, Taipei (Taiwan)* Social Links: http://www.mse.ntu.edu.tw/~cwc/news.html

	Lunch
13:30 - 14:00	**Spin-resolved momentum microscope at Taiwan Photon Source** *Dr. Der-Hsin Wei (魏德新), National Synchrotron Radiation Research Center, Hsinchu (Taiwan)* Social Links: https://www.nsrrc.org.tw/chinese/research8_1_peem.aspx
14:00 - 14:30	**Electrical and Strain Manipulation of Large Transverse Responses in Topological Antiferromagnets** *Prof. Satoru Nakatsuji, University of Tokyo, Tokyo (Japan)* Social Links: https://www.nakatsuji-lab.phys.s.u-tokyo.ac.jp/?lang=en
	Coffee break
14:50 - 15:20	**Interplay of chirality and magnetism – new phenomena at the frontier of physics and chemistry** *Prof. Dr. hab. Lech Tomasz Baczewski, Institute of Physics PAS, Warsaw (Poland)* Social Links: http://www.ifpan.edu.pl/sdvs/en/on3.4.html
	Panel Discussion (Q&A) - Spintronics for SDGs - Perspectives and Challenges

15:20 - 16:50

Moderator:

Prof. Jung-Chun-Andrew Huang (黃榮俊)

President of Taiwan Association for Magnetic Technology

Distinguished Professor of Department of Physics, National Cheng-Kung University

Panelists:

1. *Prof. Stéphane Mangin*
2. *Dr. Simon Granville*
3. *Prof. Satoru Nakatsuji*
4. *Prof. Dr. hab. Lech Tomasz Baczewski*
5. *Dr. Shang-Fan Lee (李尚凡)*

   Research Fellow& Deputy Director of Institute of Physics, Academia Sinica
6. *Prof. Wen-Chin Lin (林文欽)*

   Professor of Department of Physics, National Taiwan Normal University

Stephane Mangin

Professor

Université de Lorraine

Research Field: Energy efficient control of ultrafast spin current

Professor at Lorraine University and head of the Spintronic and Nanomagnetism team at IJL https://spin.ijl.cnrs.fr. He is a recognized expert in the fields of nanomagnetism and spintronic with 215 publications, more than 9000 citations and an h index of 46. he has 25 years of experience with magnetic nanostructures growth, processing and characterization. Its main fields of scientific expertise are magnetization manipulation at the nanometer scake using different stimulus (magnetic field, charge and spin current, heat and ultra-fast laser. Stephane Mangin is Fellow of the American Physical Society, Fellow of the IEEE Magnetic Society and Fellow at Churchill College – Cambridge (UK).

All Optical Magnetization Manipulation

S. Mangin [a]

[a] *Université de Lorraine, Institut Jean Lamour, UMR CNRS 7198 , France*

During the last decade all-optical ultrafast magnetization switching in magnetic material thin film without the assistance of an applied external magnetic field has been explored [1,2]. It has been shown that femto-second light pulses can induce magnetization reversal in a large variety of magnetic materials [3,4]. However, so far, only certain particular ferrimagnetic thin films exhibit magnetization switching via a *single* femto-second optical pulse. All optical helicity dependent switching of a ferromagnetic layer could be demonstrated for a low number of pulses [5]. Recently the single-pulse switching of various magnetic material (ferrimagnetic, ferromagnetic) within a magnetic spin-valve structure have been demonstrated. Our experimental study reveals that the magnetization states are determined by spin-polarized currents generated by the light pulse interactions with the GdFeCo layer [6]. A detail study showing how spin-polarized currents are generated and how they interact with a Ferromagnetic (FM) layer can lead to magnetization switching will be presented [7,8]. Finally, magnetization dynamics measurement show that the reversal of the FM layer happens in less than one picosecond which can be modelled [9].

Reference:

[1] C. D. Stanciu, et al Phys. Rev. Lett. **2007**, 99, 047601

[2] P. Scheid, et al J. Mag Mag Mat 169596 **2022**

[3] S. Mangin, et al, Nat. Mater. **2014**, 13, 286

[4] C. -H. Lambert, et al Science **2014**, 345, 1337

[5] G. Kichin, et al Phys. Rev. App. 12 (2), 024019 **2019**

[6] S. Iihama et al Adv Matter 1804004 **2018**

[7] Q. Remy, et al Adv. Sci. 2001996 2020

[8] J. Igarashi, et al Nano. Lett. 20, 12, 8654–8660 **2020**

[9] Q. Remy, et al under review **2022**

Chih-Huang Lai

Chair Professor

National Tsing Hua University

Research Field: Materials for low energy consumption spintronics

Prof. Lai received his Ph.D. in Materials Science and Engineering from Stanford University in 1997. He joined Read-Rite Co. and worked on TMR and GMR heads. He became an assistant Professor in National Tsing Hua University (NTHU) in 1998. Prof. Lai was Dean of College of Engineering in NTHU (2016-2022) and is Associate Dean of College of Semiconductor Research. He is Tsing Hua Chair Professor and Micron Chair Professor. His research works focus on magnetic materials, spintronic devices and CIGS thin film solar cells. He has published more than 200 peer-reviewed SCI papers and obtained more than 50 patents. He is an IEEE Fellow and MRS-Taiwan Fellow.

A spin-orbit torque device toward energy-efficient neuromorphic Spintronics

Chih-Huang Lai [a], Rudis Ismael Salinas [a], Po-Chuan Chen [a], Sheng-Huai Chen [a], and Chao-Yao Yang [b]

[a] *Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu 300044, Taiwan.*

[b] *Department of Materials Science and Engineering, National Yang Ming Chiao Tung University, Hsinchu 300093, Taiwan.*

The spintronic device has been considered as a promising candidate for neuromorphic computing because of its intrinsic non-volatility, ultrafast switching dynamics, and scalability. The spin-orbit torque (SOT) devices with precise control over the intermediate states for multi-levels have been demonstrated as promising artificial synapses for neuromorphic computing. In this study, we demonstrate a SOT device composed of Pd/Co/Ta trilayer features robust stabilization of intermediate magnetic states, which leads to precise controllability of multi-levels. Magnetization reversal of Pd/Co/Ta devices by SOT takes place through the gradual nucleation of reversed domains with restricted domain wall (DW) motion due to DW precession over Walker breakdown, which guarantees stable magnetic multi-levels. In addition, we also demonstrate that the switching of the SOT devices at the lowest energy consumption can occur at specific pulse duration, called chronaxie, commonly observed in biological neurons. Our findings will open a revolutionary avenue for establishing biomimetic neurons toward the energy and time efficient neuromorphic technology.

Simon Granville

Senior Scientist

Principal Investigator of MacDiarmid Institute and a Senior Scientist in the Robinson Research Institute, Victoria University of Wellington, Wellington (New Zealand)

Research Field: Magnetism Without Angular Momentum

Dr. Simon Granville is a Senior Scientist at the Robinson Research Institute of Victoria University of Wellington in New Zealand and a Principal Investigator of the MacDiarmid Institute for Advanced Materials and Nanotechnology. He is an experimental materials physicist working on magnetic materials and devices, especially thin film rare earth nitrides and Heusler alloys. His current projects include developing energy-efficient, ultra-high-speed and high-performance magnetic memory and logic for superconducting computing; spintronic sources of THz waves; and magnetic sensors for monitoring infrastructure. He also investigates the spintronic and spin caloritronic properties of ferromagnetic Weyl semi-metal thin films and devices.

Magnetic semiconductor rare earth nitrides – spintronic materials for energy-efficient cryogenic computing memories

S. Granville [1,2], K. van Koughnet [2,3], E. Trewick [2,3], C. Pot [2,3], W. Holmes-Hewett [2,3], J. D. Miller [2,3], R. G. Buckley [1,3], H. J. Trodahl [2], and B. J Ruck [2,3]

[1] *Robinson Research Institute, Victoria University of Wellington, New Zealand*

[2] *School of Chemical and Physical Sciences, Victoria University of Wellington, New Zealand*

[3] *MacDiarmid Institute for Advanced Materials and Nanotechnology, New Zealand*

At current trends, energy use for computing will reach 40% of the world's electricity production and 10% of all the world's energy production, by the early 2030s [1,2]. Even if existing transistor-based processing continues to improve as the Si technology base approaches long-touted physical limits, it will soon be imperative to change to a less energy-intensive form of computing.

Cryogenic computing based on superconductors could provide a solution for replacing the most energy-intensive data centres and cloud computing facilities [3]. However, there is no type of memory operable at cryogenic temperatures that can make superconducting computing realistic. Spintronic memory types have the scalability, energy-efficiency and non-volatility required, but the metallic magnetic materials used in them do not meet the needs of hybrid magnetic-superconducting memories.

The rare earth nitrides (RENs) are series of magnetic semiconductors well-suited for superconducting electronics – they have highly tuneable conductivities, saturation magnetisations and coercive fields spanning orders of magnitude [4,5]. They can also be alloyed to achieve zero net magnetisation at full magnetic alignment [6], ideal for high-speed memories in superconducting environments without fringe magnetic fields. In this talk I will cover our studies of thin films and structures made from RENs and (RE_1, RE_2)N alloys, towards solving the problem of memory for scalable superconducting logic, as needed in energy-efficient cryogenic computer concepts, such as quantum computers. I will conclude by describing our concept cryogenic MRAM structures that are can be read by and integrated directly with superconducting electronics.

Reference:

[1] Decadal Plan for Semiconductors, Semiconductor Research Corporation (2021) https://www.src.org/about/decadal-plan/

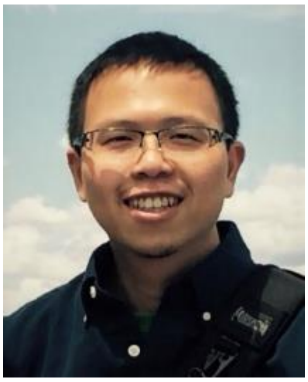
[2] D. Natelson, The need for energy-efficient computing [blog post] (2022, November 15)

[3] D. S. Holmes et al., Computer 48, 34 (2015).

[4] C.-M. Lee et al., Appl. Phys. Lett. 106, 022401 (2015)

[5] A. Shaib et al., AIP Adv. 11, 015125 (2021)

[6] J. D. Miller et al., Phys. Rev. B 106, 174432 (2022)



Chi-Feng Pai

Research Scientist / Associate Professor

TSMC / National Taiwan University

Research Field: Energy efficient spin transfer torque-magnetoresistive random access memory

Professor Chi-Feng Pai is an IEEE Senior Member and an active researcher/educator in the field of spintronics and magnetism. Prof. Pai received his Ph.D. in Applied & Engineering Physics from Cornell University in 2014. After graduating from Cornell, he worked at Massachusetts Institute of Technology as postdoctoral research associate in Department of Materials Science and Engineering. He is currently a faculty member in the Department of Materials Science and Engineering at National Taiwan University (2016-present), the elected Chair of IEEE Magnetics Society Taiwan Chapter (2022-present), and Research Scientist in the Corporate Research of Taiwan Semiconductor Manufacturing Company (2022-present). He is also the recipient of Asian Union of Magnetics Societies (AUMS) Young Researcher Award in 2016 and the co-author of "Magnetic Memory Technology: Spin-Transfer Torque MRAM and Beyond" published by Wiley-IEEE Press (1st Edition, 2021).

Building Efficient Spin-Orbit MRAMs with Orbital Hall Materials

Chi-Feng Pai [a,b], Chen-Yu Hu [a], Yu-Fang Chiu [a], Chia-Chin Tsai [a], Chao-Chung Huang [a], Kuan-Hao Chen [a], Cheng-Wei Peng [a], Chien-Min Lee [b], Ming-Yuan Song [b], Yen-Lin Huang [b], Shy-Jay Lin [b], and Xinyu Bao [b]

[a] *Department of Materials Science and Engineering, National Taiwan University*

[b] *Corporate Research, Taiwan Semiconductor Manufacturing Company*

5*d* transition metals (TMs) such as W and Pt are the classical spin Hall materials for efficient generation of spin-orbit torques (SOTs) in TM/ferromagnetic layer (FM) heterostructures. However, for a long while with tremendous engineering endeavours, the damping-like SOT efficiencies (ξ_{DL}) of W, Pt and their alloys are still limited to $\xi_{DL} < 0.5$. In this presentation, I will show that with proper alloying elements, particularly strong orbital Hall effect (OHE) 3*d* transition metals V and Cr, the strength of the high spin-orbital Hall conductivity of Pt ($\sigma_{SH} \sim 6.45\times10^5(\hbar/2e)\Omega^{-1}\cdot m^{-1}$) can be developed. Especially for the Cr-doped case, an extremely high

$\xi_{DL} \sim 0.9$ in a $Pt_{0.69}Cr_{0.31}$/Co device can be achieved with a moderate $Pt_{0.69}Cr_{0.31}$ resistivity of $\sim$133 μΩ · cm. A low critical SOT-driven switching current density of $J_c \sim 3.16\times10^6 A\cdot cm^{-2}$ is also demonstrated. The damping constant (α) of $Pt_{0.69}Cr_{0.31}$/FM structure is also found to be reduced to 0.052 from the pure Pt/FM case of 0.078. The overall high σ_{SH}, giant ξ_{DL}, moderate resistivity, and reduced α of such Pt-Cr/FM heterostructure makes it promising for versatile extremely low power consumption SOT memory applications.

Chun-Wei Chen

Distinguished Professor

Department of Materials Science and Engineering, National Taiwan University

Research Field: Spin polarized catalyst

Prof. Chen is currently a Distinguished professor at the Department of Materials Science and Engineering, National Taiwan University (NTU). He is also currently the director of International Graduate Program of Molecular Science and Technology (NTU-MST), National Taiwan University. He has widely contributed to his research on two-dimensional(2D) atomic-layer materials and next-generation energy materials such as organic-inorganic hybrid perovskites. He was a recipient of Outstanding Researcher Award (2011 and 2015) from the National Science Technology Council, Taiwan and Outstanding Scholar Awards, Foundation for the Advancement of Outstanding Scholarship (2017). He became the Fellow of School of Engineering, University of Tokyo, Japan in 2022.

Manipulating spin-polarized electrons of electrocatalyst and photocatalyst for energy conversion

Chun-Wei Chen

Department of Materials Science and Engineering, National Taiwan University, Taipei 106, Taiwan

E-mail: chunwei@ntu.edu.tw

"Spin" has been recently reported as an important degree of electronic freedom to improve the performance of electrocatalysts and photocatalysts. In this talk, I would like to present our recent results on manipulating spin-polarized electrons of electrocatalysts and photocatalysts for energy conversion. In the first part, I would like to show the manipulation of spin-polarized electrons in $CsPbBr_3$ halide perovskite nanoplates (NPLs) to boost the photocatalytic CO_2 reduction reaction (CO_2RR) efficiencies by doping manganese cations (Mn^{2+}) and applying an external magnetic field. [1] The origin of enhanced photocatalytic CO_2RR efficiencies of Mn-CsPbBr3 NPLs is due to the increased number of spin-polarized photoexcited carriers by synergistic doping of the magnetic elements and applying a magnetic field, resulting in prolonged carrier lifetime and suppressed charge recombination.

In the second part, I would like to show the enhanced oxygen evolution reaction (OER) catalytic activity of two-dimensional van der Waals metal phosphosulfides of $FePS_3$ and $Fe_xCo_{1-x}PS_3$ (x=0-0.45) by controlling their spin exchange interactions. [2] The origin of enhanced OER catalytic activity is mainly resulting from enhanced spin-polarization of Co-doped $FePS_3$ due to the suppression of antiferromagnetic (AFM) orbital orderings and the emergence of weak interatomic ferromagnetism (FM) compared to the pristine $FePS_3$.[2] Both examples show that manipulating spin-polarized electrons of electrocatalysts and photocatalysts provides an effective strategy to boost their energy conversion efficiencies.

Reference:

[1] Cheng-Chieh Lin, Ting-Ran Liu, Sin-Rong Lin, Karunakara Moorthy Boopathi, Chun-Hao Chiang, Wen-Yen Tzeng, Wan-Hsiu Chang Chien, Hua-Shu Hsu, Chih-Wei Luo, Hui-Ying Tsai, Hsin-An Chen,Pai-Chia Kuo, Jessie Shiue, Jau-Wern Chiou, Way-Faung Pong, Chia-Chun Chen,*and Chun-Wei Chen*," *Spin-Polarized Photocatalytic CO_2 Reduction of Mn-Doped Perovskite Nanoplates"*, ***Journal of American Chemical Society***, 144,15718, (2022)

[2] *Manuscript in preparation*.

Der-Hsin Wei

Research Scientist

National Synchrotron Radiation Research Center

Research Field: Spin-resolved soft X-ray photoemission electron microscope at the Taiwan Photon Source

Dr. Der-Hsin Wei is a Research Scientist working at the National Synchrotron Radiation Research Center (NSRRC). Dr. Wei's research interests are soft x-ray spectromicroscopy, low-dimension physics, and magnetism. He is now the spokesperson of TPS 27A2 and the Deputy Director of NSRRC.

Spin-resolved momentum microscope at Taiwan Photon Source

Der-Hsin Wei [a], Tzu-Hung Chuang [a], Chuan-Che Hsu [a], Jyun-Syong Jhuang [a],
I-Chun Yeh [a,b], Wei-Sheng Chiu [a,c], Wei-Ting Hsu [b], Shangjr Gwo [a,b], and Chih-Kang Shih [b,d]

[a] *National Synchrotron Radiation Research Center, Taiwan*

[b] *Department of Physics, National Tsing Hua University, Taiwan*

[c] *Graduate Institute of Applied Since and Technology, National Taiwan University of Science and Technology, Taiwan*

[d] *Department of Physics, the University of Texas at Austin, USA*

Generation and manipulation of spin-polarized carriers play key roles in spintronic applications, yet their optimization can hardly be realized without the knowledge of electronic structures (in momentum space, ***k***-space) and magnetic microstructures (in real space, ***r***-space) of materials in use. In this talk, I will describe how the needed information mentioned above can be unraveled by the momentum microscope established recently at Taiwan Photon Source (TPS) Nano-Spectroscopy beamline 27A2. An intriguing feature of the momentum microscope at TPS 27A2 is its option to record images in either ***r***-space or ***k***-space with simply a switch that changes the settings of electron lenses. Such a feature implies that there is no more hassle in examining the electronic structures from the very same micro-meter spot of the specimen. On top of that, this momentum microscope is equipped with a spin mirror to provide spin-resolved images. Because the electron reflectivity from an Ir(001) surface is a function of an electron's energy and spin, the images recorded with reflected electrons under constant-energy mode are thus spin-resolved. Performance of the momentum microscope at TPS 27A2 is to be demonstrated with the real space images of an Au/Si chessy pattern, the constant energy contour of a single flake of two-dimensional (2D) material, and the spin-resolved Shockley surface state on Au(111) surface.

Satoru Nakatsuji

Director / Professor

Trans-scale Quantum Science Institute / Dept. of Physics, University of Tokyo

Research Field: Quantum transport phenomena in topological materials

Satoru Nakatsuji received his Ph.D in Physics from the Kyoto University in Japan in 2001 and then worked as a postdoc at National High Magnetic Field Laboratory in Florida till 2003. After he served as a lecturer of the Department of Physics at Kyoto University, he moved to University of Tokyo as an associate professor of the Institute for Solid State Physics and later became a full professor in 2016. Recently, he joined the faculty of Department of Physics of University of Tokyo as a full professor. He is currently serving as Professor at Department of Physics, Project Professor at ISSP, the Director of Trans-Scale Quantum Science Institute, UTokyo.

Electrical and Strain Manipulation of Large Transverse Responses in Topological Antiferromagnets

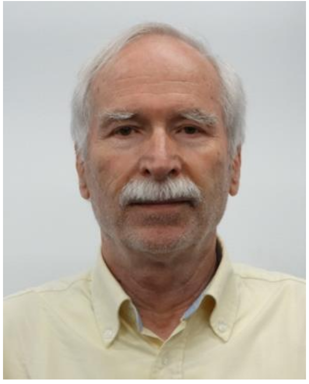
Satoru Nakatsuji [1,2,3]

[1] *Department of Physics, School of Science, The University of Tokyo, Tokyo 113-0033, JAPAN*

[2] *Institute for Solid State Physics, The University of Tokyo, Kashiwa, Chiba 277-8581, JAPAN*

[3] *Department of Physics and Astronomy, Johns Hopkins University, Baltimore, MD 21218, USA*

Macroscopic responses of magnets are often governed by magnetization and thus have been restricted to ferromagnets. However, such responses are strikingly large in the newly developed topological magnets, breaking the conventional scaling with magnetization. Taking the recently discovered antiferromagnetic Weyl semimetals as a prime example, we highlight the two central ingredients driving the significant macroscopic responses: the Berry curvature enhanced due to nontrivial band topology in momentum space, and the cluster magnetic multipoles in real space. In particular, recent discovery of the magnetic Weyl fermions in the antiferromagnet Mn_3Sn has attracted significant attention, as it exhibits various exotic phenomena with robust properties due to the Weyl nodes. Given the prospects of antiferromagnetic (AF) spintronics for realizing high-density devices with ultrafast operation, it would be ideal if one could electrically manipulate an AF Weyl semimetal. After introducing basic properties of the topological magnets, we discuss our recent work on the electrical switching as well as strain manipulation of a Weyl semimetal state and its detection by anomalous Hall effect (AHE). Our observation may well lead to another leap in science and technology for topological magnetism and ultrafast AF spintronics.



Lech Tomasz Baczewski

Professor

Head of magnetic heterostructures group, Institute of Physics,
Polish Academy of Sciences, Warsaw, Poland
Research Field: Magnetization switching in ferromagnetic thin film
Induced by adsorbed chiral helical molecules

Since 1980 employed at the Institute of Physics Polish Academy of Sciences. Scientific interests: exchange interactions in rare-earths- transition metals thin films and multilayers, spin reorientation transition in magnetic Co based nanostructures – tailoring of magnetic properties, interface related magnetic phenomena studied by Polarized Neutron Reflectivity and Xray Magnetic Circular Dichroism – induced magnetic moment, magnetic and structural studies of Co nanotubes grown on ZnTe nanowires template. Nanomagnetism – magnetic anisotropy in ultra-thin Co nanostructures depending on type of buffer

Coordinator of the Polish Scientific Network SPINLAB "Magnetic Nanostructures for Applications in Spintronics" established in 2006, acknowledged by the Polish Ministry of Science and Higher Education.

Interplay of chirality and magnetism – new phenomena at the frontier of physics and chemistry

L.T. Baczewski

Institute of Physics Polish Academy of Sciences, Warsaw, Poland

Chirality plays a critical role in a wide range of systems, from biology and chemistry to condensed matter physics and high energy physics. We have demonstrated a new effect of magnetization switching of ferromagnetic thin film without applying a magnetic or electric field but being induced solely by adsorption of chiral molecules. The direction of the magnetization depends on the handedness of the adsorbed chiral molecules. Another important result was to propose a new method of enantio-separation based on the interaction of chiral molecules with a perpendicularly magnetized substrate. It was shown that one enantiomer adsorbs preferentially when the magnetic dipole is pointing up, whereas the other adsorbs faster for the opposite magnetization alignment. Moreover the interaction is not controlled by the magnetic field but by the respective electron spin orientations of the ferromagnetic layer and chiral molecules. This method is versatile as it was tested for different kinds of chiral molecules and allows to avoid costly separation columns which has to be designed individually for a given type of chiral molecules used presently in the pharmaceutical industry.

Jung-Chun-Andrew Huang

Distinguished Professor

National Cheng Kung University

Dr. Huang received his Ph.D. degree from the University of Illinois at Urbana Champaign 1992. He then came back to Taiwan to work in the Physics Department of NCKU and became a Professor in 1997. He was the recipient of the Distinguished Professorship in NCKU (2003), and the Taiwan Magnetic Society Outstanding Research Award (2015). He was the President of the Taiwan Physics Society (2010-2012) and currently is the President of the Taiwan Association of Magnetic Technologies. His current research interests focus on the fundamental physics of quantum topological materials including topological insulators (TIs), ferromagnetic TIs, and spintronic devices based on these materials.

Shang-Fan Lee

Research Fellow and Deputy Director

Institute of Physics, Academia Sinica

Dr. Lee received his Ph.D. degree from the Michigan State University, USA. He was then a Postdoctoral researcher in the Universite Paris-Sud/CNRS, France. He then moved back to Taiwan to work in the Institute of Physics, Academia Sinica, and is now a Research Fellow and Deputy Director.

The research interest of Dr. Lee includes magnetism and magnetic materials and the interplay between magnetism and superconductivity. He has worked on the current perpendicular to plane Giant Magnetoresistance (CPP GMR), magnetic submicron and nano-structures, point-contact spectroscopy, pure spin currents, etc. His current interests include the quantum phenomena in topological materials and the transport of spin waves in magnetic nano-structures and low dimensional and/or van der Waals materials.

Wen-Chin Lin

Professor/Chairman

Department of Physics, National Taiwan Normal University

Wen-Chin Lin received his Ph.D in physics in National Taiwan University in 2006. He joined the Department of Physics, National Taiwan Normal University in 2007 and now is a full-professor and the department chair. As an experimentalist, his team in NTNU focuses on the research topics in low-dimensional magnetism and spintronic devices. Especially, much efforts have been devoted to the hydrogen-induced reversible modulation on magnetism. Currently he also studies the spinterfaces between a ferromagnetic film and a 2D-material layer, as well as the manipulation of 2D hetero structures.


Taiwan