Chi-Feng Pai 白奇峰

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Postdoctoral Research Associate
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Research Interests

Spintronics, magnetic materials, thin film deposition and nano device fabrication, low/high frequency electrical transport measurements, magneto-optical measurements

Education

Cornell University

PhD, Applied and Engineering Physics (minor in Materials Science and Engineering), 2009-2014

National Taiwan University

BEng, Material Science and Engineering / BSc, Physics (double major), 2003-2007

Experience

Postdoctoral Research Associate

Geoffrey S. D. Beach group, Massachusetts Institute of Technology, 2014-present

- Research on probing spin-orbital effects in magnetic heterostructures and novel materials with complementary optical and electrical techniques.

Research Assistant

Robert A. Buhrman group, Cornell University, 2010-2014

- Conducting research on nano-size 3-terminal spintronics devices, fabrication of magnetic tunnel junctions, the giant spin Hall effect in various transition metals, and the engineering of spin-orbital torques in magnetic heterostructures.
- Manager of the group-owned AJA seven-gun sputtering system (2010-2014).
- Mentoring REU (Research Experience for Undergraduates) students (2012-2014).

Teaching Assistant

School of Applied and Engineering Physics, Cornell University, 2009-2010

- AEP 1100 Laser and Photonics.
- AEP 2640 Computer Instrumentation Design.

Second Lieutenant of Ordnance

Republic of China (Taiwan, R.O.C.) Army, 2007-2008

- Logistic management in an armored infantry base.

Society Organizer

National Taiwan University Society of Nonlinear Science (NTUNL), 2004-2007

- Organizing lectures and presentations related to nonlinear dynamics for fellow students.

Publications

[1] L. Q. Liu*, **C.-F. Pai***, Y. Li, H. W. Tseng, D. C. Ralph, and R. A. Buhrman, "*Spin-torque switching with the giant spin Hall effect of tantalum*," Science **336**, 555 (2012).

[2] **C.-F. Pai**, L. Q. Liu, Y. Li, H. W. Tseng, D. C. Ralph, and R. A. Buhrman, "*Spin transfer torque devices utilizing the giant spin Hall effect of tungsten*," Applied Physics Letters **101**, 124404 (2012).

[3] L. Q. Liu, **C.-F. Pai**, D. C. Ralph, and R. A. Buhrman, "*Magnetic oscillations driven by the spin Hall effect in 3-terminal magnetic tunnel junction devices*," Physical Review Letters **109**, 186602 (2012).

[4] L. Q. Liu, **C.-F. Pai**, D. C. Ralph, and R. A. Buhrman, "*Gate voltage modulation of spin-Hall-torque-driven magnetic switching*," arXiv:1209.0962 (2012).

[5] K. An, D. R. Birt, **C.-F. Pai**, K. Olsson, D. C. Ralph, R. A. Buhrman, and X. Li, "*Control of propagating spin waves via spin transfer torque in a metallic bilayer waveguide*," Physical Review B **89**, 140405(R) (2014).

[6] O. J. Lee, L. Q. Liu, **C.-F. Pai**, Y. Li, H. W. Tseng, P. G. Gowtham, J. Park, D. C. Ralph, and Robert A. Buhrman, "*The central role of domain wall depinning for perpendicular magnetization switching driven by spin torque from the spin Hall effect*," Physical Review B **89**, 024418 (2014).

[7] **C.-F. Pai**, M.-H. Nguyen, C. Belvin, L. H. V.-Leão, D. C. Ralph, and R. A. Buhrman, "*Enhancement of perpendicular magnetic anisotropy and transmission of spin-Hall-effect-induced spin currents by a Hf spacer layer in W/Hf/CoFeB/MgO layer structures*," Applied Physics Letters **104**, 082407 (2014).

[8] **C.-F. Pai***, Yongxi Ou*, D. C. Ralph, and R. A. Buhrman, "*Dependence of the Efficiency of Spin Hall Torque on the Transparency of Pt-Ferromagnetic Layer Interfaces*," (submitted)

[9] M.-H. Nguyen, **C.-F. Pai**, D. C. Ralph, and R. A. Buhrman, "*Enhancement of the anti-damping*

spin torque efficacy of the spin Hall effect in Pt by interface modification" (submitted)

Presentations

[1] *A novel three-terminal spintronics device utilizing the spin Hall effect*, APS March Meeting, Boston MA, 2012 (Contributed)
[2] *Spin transfer torque devices utilizing the spin Hall effect of tungsten*, 12th Joint MMM/Intermag Conference, Chicago IL, 2013 (Contributed)
[3] *Spin transfer torque devices utilizing the spin Hall effect of tungsten*, APS March Meeting, Baltimore MD, 2013 (Contributed)
[4] *The spin Hall effect in transition metal-ferromagnetic material bilayer devices*, APS March Meeting, Baltimore MD, 2013 (**Invited**)
[5] *The spin Hall effect in Tantalum and Tungsten-based systems*, 1st International Workshop on Spin-Orbit Induced Torque, KAUST, Jeddah, Saudi Arabia, 2013 (**Invited**)
[6] *Comparative studies of anti-damping and field-like torques generated by spin-orbit interactions in NM/FM/Oxide structures via low frequency and high frequency techniques*, 58th Annual Conference on Magnetism and Magnetic Materials, Denver CO, 2013 (Contributed)
[7] *Enhanced perpendicular magnetic anisotropy and spin-orbit torques in W/Hf/CoFeB/MgO layer structures*, Workshop on Current-Driven Magnetisation Dynamics, Leeds, UK, 2014 (**Invited**)
[8] *Dependence of the Spin Hall Torque Efficiency on the Transparency of Pt-Ferromagnetic Layer Interfaces, APS March Meeting*, San Antonio TX, 2015 (Contributed)

Patents

[1] "Spin hall effect magnetic apparatus, method and applications": PCT/US2012/051351 WO2013025994. Inventors: Robert A. Buhrman, Daniel C. Ralph, Luqiao Liu, Chi-Feng Pai.

Technical Expertise

General Materials Growth / Fabrication Processing

- E-beam lithography (JEOL e-beam lithography system)
- Photolithography (Contact Aligner, Stepper)
- Ion-milling
- DC/RF sputtering (Manager of an AJA sputtering system)
- Reactive-ion etching
- Atomic Layer Deposition

Materials Characterization / Electrical Testing

- Magnetometry (VSM and SQUID)

- Atomic force microscopy (AFM)
- Scanning electron microscopy (SEM)
- X-ray diffraction analysis (XRD)
- Low frequency and high frequency electrical/magneto measurements / DC, AC, and RF transport measurements (Quantum Design PPMS, Lakeshore probe stations, home-made GMW magnet probe stations… etc.)

Programming Languages

- LabVIEW, Matlab, Mathematica, Python (basic), and Java (basic)

Languages

English (Professional working proficiency)
Chinese and Taiwanese (Native)