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FRANK Q. ZHU, PH. D.

EDUCATION

- 2007.4–present Johns Hopkins University Baltimore, MD
Associate Research Scientist
- 2006.4–2007.4 Johns Hopkins University
Postdoctoral Fellow
- 2002.5–2006.4 Johns Hopkins University
Ph. D., Condensed Matter Physics
- 1999.9–2002.5 Johns Hopkins University
M. A., Condensed Matter Physics
- 1996.9–1999.6 Nanjing University Nanjing, China
M. Sc., Microelectronics and Solid State Physics
- 1992.9–1996.6 Nanjing University Nanjing, China
B. Sc., Department of Intensive Instruction for Most Talented Youth

RESEARCH AND EXPERIENCES

- **Research Assistant and Postdoctoral Period** (Sept. 2000 – Apr. 2007)
 - Fabrication and properties of nanorings (diameter 50-500 nm, magnetic single layer or multilayers, superconducting nanorings)
 - Large area fabrication of nanodots with perpendicular anisotropy (Co/Pt)
 - Exchange bias in magnetic thin films and nanostructures
 - Spin transport with ferromagnets (Fe, Co, Ni), semi-metals (Bismuth) and half-metallic oxides (CrO₂) and Heusler alloys (Co₂MeGe etc.)
 - Electrochemical deposition in nanoporous templates (Polycarbonate membrane, Porous Alumina, Self-assembled nanosphere templates)
 - Self-assembly and manipulation of nano-particles
 - Laser Micromachining for microdevices (e.g. direct circuit writing, chip correction, photo mask generation, micro-electrode patterning)
- **Teaching** (1998 – 2007)
 - Creating and teaching an intersession class
 - “*Magnetolectronics Materials and Devices*”, Jan. 2006 & Jan 2007
 - Teaching computer classes
 - “*Introduction to Mathematica*”, 2005
 - “*Introduction to Photoshop*”, 2005
 - Supervising MRSEC Summer High School Interns,
 - “*Writing on a hair’s breadth*”(July 2002),
 - “*Domain patterns of Ni film*” (July 2006),
 - “*Writing Nanopatterns with FIB*”(July 2007)
 - Teaching assistant for *General Physics Laboratory I & II*, Sept. 1999 – June 2000
 - Teaching “*Digital Image Processing*”, Nanjing University, 1998

- **Other Research Experience** (Sept. 1996 – June 1999)
 - Silicon-based light emitting materials, such as Porous Silicon, embedded SiC nanoparticles in Si
 - Fabrication of anodized alumina templates integrated on Si substrate

THESIS ADVISOR

Prof. C. L. Chien (clc@pha.jhu.edu)
 Department of Physics and Astronomy
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PUBLICATIONS



1. **F. Q. Zhu**, S. H. Lee, N. Markovic and C. L. Chien, “*Perpendicular Magnetic Anisotropy and Domain Wall Resistance In Thermally Evaporated Nickel Films*”, submitting to **Appl. Phys. Lett.** (2008).
2. **F. Q. Zhu**, V. Thampy and C. L. Chien, “*A novel method for accurate determination of the blocking temperature of exchange biased bilayer systems*”, submitting to **Appl. Phys. Lett.** (2008).
3. D. L. Fan, **F. Q. Zhu**, R. C. Cammarata and C. L. Chien “*Electric properties of Multiwall carbon nanotubes determined by electro-rotation in AC electric fields*”, submitting to **Phys. Rev. Lett.** (2008).
4. S. H. Lee, **F. Q. Zhu**, C. L. Chien and N. Markovic, “*Effect of Geometry on Magnetic Domain Structure in Thermally Evaporated Ni Strips*”, **Phys. Rev. B** **77**, 132408 (2008).
5. H. X. Wei, **F. Q. Zhu**, X. F. Han, Z. C. Wen, and C. L. Chien, “*Current-induced multiple spin structures in 100-nm nanoring magnetic tunnel junctions*”, **Phys. Rev. B.** (accepted, 2008).
6. Zhu Liu, Guoqiang Xia, **Frank Zhu**, Su Kim, Nina Markovic, Chia-Ling Chien, and Peter C. Searson, “*Exploiting finite size effects in a novel core/shell microstructure*”, **J. Appl. Phys.** **103**, 064313 (2008).
7. C. L. Chien, **F. Q. Zhu** and J. G. Zhu, “*Patterned Nanomagnets*”, **Physics Today** **60**, 40 (2007).
8. **F. Q. Zhu**, Z. Shang, D. Monet and C. L. Chien, “*Large Enhancement of Coercivity of Magnetic Co/Pt Nanodots with Perpendicular Anisotropy*”, **J. Appl. Phys.** **101**, 09J101 (2007).
9. Y. W. Hao, **F. Q. Zhu**, C. L. Chien and P. C. Searson, “*Fabrication and Magnetic Properties of Ordered Macroporous Nickel Structures*”, **J. Electrochem. Soc.** **154**, D65 (2007).
10. D. L. Fan, **F. Q. Zhu**, R. C. Cammarata and C. L. Chien, “*Efficiency of assembling of nanowires in suspension by AC electric fields*”, **Appl. Phys. Lett.** **89**, 223116 (2006). ♦ selected as cover article
11. **F. Q. Zhu**, G. W. Chern, O. Tchernyshyov, X. C. Zhu, J. G. Zhu and C. L. Chien, “*Magnetic bistability and controllable reversal of asymmetric ferromagnetic nanorings*”, **Phys. Rev. Lett.** **96**, 27205 (2006).
 ♦ Reported by Virtual Journal of Nanoscale Science and Technology, Jan 30, 2006.
 ♦ In more than 50 news such as PhysOrg.com, EETimes, Electronics Weekly, Eurek Alert etc.
12. W. L. Lee, **F. Q. Zhu** and C. L. Chien, “*Determination of domain walls resistance in a cobalt thin film by means of thickness modulation*”, **Appl. Phys. Lett.** **88**, 122503 (2006).
13. D. L. Fan, **F. Q. Zhu**, R. C. Cammarata and C. L. Chien, “*Nanowire rotation and micromotors*”, **Physics** (Invited paper in Chinese) **35**, 197 (2006).
14. **F. Q. Zhu** and C. L. Chien, “*Determination of multiple easy axes in magnetic multilayers by remanence measurement using a vector magnetometer*”, **J. Appl. Phys.** **97**, 10J110 (2005).
15. **F. Q. Zhu**, F. Y. Yang, C. L. Chien, L. Ritchie, G. Xiao, G. H. Wu, “*Magnetic and thermal properties of Ni-Mn-Ga shape memory alloy with near room temperature transition*”, **J. Magn. Magn. Mater.** **288**, 79 (2005).
16. D. L. Fan, **F. Q. Zhu**, R. C. Cammarata and C. L. Chien, “*Controllable high-speed rotation of nanowires*”, **Phys. Rev. Lett.** **94**, 247208 (2005).

- ◆ Reported by Virtual Journal of Nanoscale Science and Technology, July 11, 2005.
 - ◆ In more than 40 news such as PhysOrg.com, Nano Today, APS News etc.
17. **F. Q. Zhu**, D. L. Fan, X. C. Zhu, J. G. Zhu, R. C. Cammarata, C. L. Chien, "Arrays of magnetic nanorings with ultrahigh areal densities", Advanced Materials **16**, 2155 (2004).
 18. **F. Q. Zhu**, D. L. Fan, R.C. Cammarata, C. L. Chien, "Magnetic and magneto-transport properties of electrodeposited magnetic nano-network on laser modified Au surface", J. Appl. Phys. **95**, 6989 (2004).
 19. D. L. Fan, **F. Q. Zhu**, R. C. Cammarata and C. L. Chien, "Manipulation of nanowires in suspension by ac electric fields", Appl. Phys. Lett. **85**, 4175 (2004).
 - ◆ Reported by Virtual Journal of Nanoscale Science and Technology, Nov 15, 2004.
 20. Donglei Fan, **F. Q. Zhu**, Ingrid X. Shao, P. C. Searson, and R. C. Cammarata, "Real Time In Situ Stress Evolution Investigation of Highly Textured Electrodeposited Bismuth Thin Films", Mat. Res. Soc. Symp. Proc. Vol. **781E** (2003).
 21. Jianping Zou, Junhui Wu, **Qing Zhu**, Lin Pu, Jianmin Zhu and Ximao Bao, "Anodic Characteristic During Anodizing of Electron-beam Evaporation Aluminum Film on Si Substrate", Chinese Journal of Semiconductors **21**, 255 (2000).
 22. Junhui Wu, Jianping Zou, Lin Pu, **Qing Zhu** and Ximao Bao, "Crystallinity Dependence of Self-organized Process During Porous Anodization of Aluminum", Chinese Journal of Chemical Physics, **13**, 203 (2000).
 23. Jun-hui Wu, Jian-ping Zou, **Qing Zhu**, Xi-mao Bao, "Study on Photoluminescence from Anodic Alumina Films Formed on Silicon Substrate", Chinese Journal of Luminescence **21**, 53 (2000).
 24. Junhui Wu, Jianping Zou, **Qing Zhu**, Ximao Bao, "AES Multi-layer Structural Analysis of Si-based Anodic Porous Alumina Films and Studies on Its Formation Mechanism", Electrochemistry (Chinese) **5**, 389 (1999).
 25. Junhui Wu, Jianping Zou, **Qing Zhu**, Ximao Bao, "Structural Modeling of Si-based Anodic Porous Alumina Films formed in Sulfuric Acid", Chinese Journal Chemical Physics **12**, (1999).
 26. Junhui Wu, Jianping Zou, **Qing Zhu** and Ximao Bao, "Fabrication of Ordered Nanopore Arrays of Alumina on Silicon Substrate", Chinese Journal of Semiconductors **20**, 314 (1999).
 27. Yixiu Wu, Yao Yu, Yuansheng Pan, **Qing Zhu**, Quanlin Fan and Yonghua Pan, "Measurement of the Refractive Index Using the Computer Moire Deflectometry", Applied Laser (Chinese) **17**, 184 (1997).

PATENTS



1. **F. Q. Zhu** and C. L. Chien, "Ferromagnetic Nanorings", USPTO # 60/661,569, Mar. 2005.
2. D. L. Fan, **F. Q. Zhu**, C. L. Chien and R. C. Cammarata, "Nanowire Transport, Assembly, and Rotation in Suspension by AC Electric Fields ", USPTO # 60/611,748, Sept. 2004.

PRESENTATIONS



1. *Ferromagnetic Shape Memory Alloy Ni_{51.9}Mn_{23.2}Ga_{24.9} with Martensitic Transformation Near Room Temperature*
47th Conference on Magnetism and Magnetic Materials, Nov. 2001, Seattle, WA
2. *Magnetic and Magneto-transport Properties of Electrodeposited Magnetic Nano-network on Laser Modified Au Surface*
9th Joint MMM/Intermag Conference, Jan 2004, Anaheim, CA
3. *Arrays of magnetic nanorings with ultrahigh areal densities*
APS Annual March Meeting, Mar. 2004, Montreal, Canada

4. *Determination of multiple easy axes in magnetic multilayers by remanence measurement using a vector magnetometer*
49th Conference on Magnetism and Magnetic Materials, Nov. 2004, Jacksonville, FL
5. *Temperature dependence of non-collinear interlayer coupling across an antiferromagnetic layer in Py/FeMn/Co*
49th Conference on Magnetism and Magnetic Materials, Nov. 2004, Jacksonville, FL
6. *High Density Arrays of Ferromagnetic Nanorings on a Macroscopic Area*
2005 Materials Science Research Symposium, Apr. 2005, Baltimore, MD
7. *Painless Glucose Manager*
Baltimore City Mosh Pit business plan competition sponsored by Greater Baltimore Technology Council, Apr. 2005, Baltimore, MD
8. *Controllable magnetic reversal of asymmetric ferromagnetic nanorings*
50th Conference on Magnetism and Magnetic Materials, Nov. 2005, San Jose, CA
9. *Fabrication and magnetic properties of 100 - 500 nm ferromagnetic nanorings arrays with high areal densities*
Material Research Society 2005 Fall meeting, Boston, MA
10. *Controllable reversal of asymmetric magnetic nanorings*
APS Annual March Meeting, Mar. 2006, Baltimore, MD
11. *Magnetic Switching Properties of Mesoscopic Permalloy Discs Prepared by Nanosphere Lithography*
51st Conference on Magnetism and Magnetic Materials, Nov. 2006, Baltimore, MD
12. *Perpendicular magnetic anisotropy and domain wall magnetoresistance of thermally evaporated Nickel films*
52nd Conference on Magnetism and Magnetic Materials, Nov. 2007, Tampa, MD

AWARDS



1. **Finalist of Best Student Presentation Award**, 50th Conference on Magnetism and Magnetic Materials, Nov. 2005, San Jose, CA. (sponsored by HGST)
2. **Student Travel Award**, 50th Conference on Magnetism and Magnetic Materials, Nov. 2005, San Jose, CA. (sponsored by HGST)
3. **Prize winner** of 2005 Baltimore City Business Plan competition, team leader, 3rd place & \$5000 award.
4. **Henry. A Rowland** prize for Innovation and Excellence in Teaching, Johns Hopkins University, 2000.

AFFILIATIONS

American Physical Society (APS), Material Research Society (MRS), National Geographic Society, Baltimore Classic Music Station (WBJC)