

# Curriculum Vitae of Biao Hu

## Dr. Biao Hu

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### EDUCATION

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**Ph.D.** in Condensed Matter Physics August 2011  
Louisiana State University, Baton Rouge, LA  
Dissertation: "Evolution of Structural and Physical Properties of Transition Metal Oxide  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$  ( $0 \leq x \leq 0.7$ ) with Mn Concentration"  
Supervisors: Prof. Ward Plummer & Prof. Rongying Jin

**M.S.** in Physics July 2005  
Fudan University, Shanghai, China  
Thesis: "Stability of adatoms and islands on Ag(111) and Cu(111) surfaces"  
Supervisor: Prof. Xi-Jing Ning

**B.S.** in Physics July 2002  
Lanzhou University, Lanzhou, China

### PROFESSIONAL EXPERIENCE

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*Postdoctoral Fellow* October 2011 – Present  
Department of Mechanical Engineering, The University of Texas at Austin Supervisor: Prof. Jianshi Zhou

- Grew single crystals of  $\text{YTiO}_3$ , high temperature superconductor  $(\text{La}_{1-x}\text{Sr}_x)_2\text{CaCu}_2\text{O}_{6+\delta}$ , colossal magnetoresistance manganite  $\text{La}_{2-2x}\text{Sr}_{1+2x}\text{Mn}_2\text{O}_7$  via Float Zone (FZ)/ Traveling Solvent FZ method
- Characterized structural properties of  $\text{YTiO}_3$ ,  $(\text{La}_{1-x}\text{Sr}_x)_2\text{CaCu}_2\text{O}_{6+\delta}$ , and  $\text{La}_{2-2x}\text{Sr}_{1+2x}\text{Mn}_2\text{O}_7$  via XRD and Laue back diffraction
- Measured electrical, magnetic, thermopower and thermal conductivity properties of  $\text{YTiO}_3$ ,  $(\text{La}_{1-x}\text{Sr}_x)_2\text{CaCu}_2\text{O}_{6+\delta}$ , and  $\text{La}_{2-2x}\text{Sr}_{1+2x}\text{Mn}_2\text{O}_7$
- Concentration analysis of  $\text{La}_{2-2x}\text{Sr}_{1+2x}\text{Mn}_2\text{O}_7$  using ICP-MS and thermal analysis of  $\text{La}_{2-2x}\text{Sr}_{1+2x}\text{Mn}_2\text{O}_7$  using TG-TDA
- Set up a high concentration ozone generation apparatus to oxidize high temperature superconductors

*Graduate Research Assistant* August 2005 – August 2011  
Department of Physics & Astronomy, The University of Tennessee/Oak Ridge National Laboratory & Louisiana State University Supervisors: Prof. Ward Plummer & Prof. Rongying Jin

# Curriculum Vitae of Biao Hu

## Synthesis and Characterization of Transition Metal Oxides

- Grew high quality single crystals  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$  ( $0.0 \leq x \leq 0.7$ ) and  $\text{Ca}_{2-x}\text{Sr}_x\text{RuO}_4$  ( $x = 0.3, 1.0$ ) via Floating Zone method
- Crystallographic structures of single-crystalline  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$  via single-crystal x-ray diffraction (XRD)
- Resistivity, Specific Heat, Hall Coefficient, Thermo Transport measurements of  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$  based on PPMS (Model 6000, Quantum Design)
- Magnetic Susceptibility measurements under MPMS-XL (7T) and Vibrating Sample Magnetometer (14T) (Quantum Design)
- Constructed a phase diagram in  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$ , showing metal-to-insulator transition and magnetic transition
- Determined magnetic structure of single crystal  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$  ( $x = 0.16$ ) via elastic neutron scattering experiment
- Heat Capacity measurement under Dilution Refrigerate option on PPMS
- Surface topography and compositions of  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$  via Scanning Electron Microscope (SEM) & Energy-dispersive X-ray Spectroscopy (EDS)
- High resolution Transmission electron microscopy (TEM) imaging of  $\text{Sr}_3\text{Ru}_2\text{O}_7$

## Surface science related work

- Investigated surface structure of ruthenate  $\text{Sr}_3\text{Ru}_2\text{O}_7$  and iron pnictide superconductors  $\text{BaFe}_{2-x}\text{Co}_x\text{As}_2$  by quantitative Low Energy Electron Diffraction (LEED  $I$ - $V$ ) spectra
- Studied surface lattice dynamics of single layered ruthenate by High Resolution Electron Energy Loss Spectroscopy (HREELS, LK 2000)
- Participated in the design and build of an integrated system with LEED, HREELS (LK 5000), Variable Temperature Scanning Tunneling Microscopy (VT-STM, Omicron), Molecule Beam Epitaxy (MBE) and X-ray Photoemission Spectroscopy (XPS).
- Tested the new high resolution electron energy loss spectrometer (LK 5000) in a direct beam mode

*Graduate Research Assistant*

September 2002 - July 2005

Institute of Modern Physics, Fudan University, Shanghai, China

Supervisor: Prof. Xi-Jing Ning

- Investigated decaying mechanism of adatom on solid surface via molecular dynamics (MD) simulation
- Simulated pulsed laser deposition (PLD) process of Cu clusters on Cu(111) surface via MD method

## TECHNICAL SKILLS

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### Crystal growth

- Single crystal growth via Floating Zone method in **Optical Image Furnaces** with two halogen lamps (Model: Canon SC1-MDH20020; NEC SC-M15HD and NEC SC-M35HD) and four Xenon lamps (Model: FZ-T-12000-X-VPM-PC, Crystal Systems Corp.)
- Synthesis of polycrystals via conventional solid-state reaction
- Grow single crystals via self-flux method
- Czochralski (CZ) method and Bridgman technique
- Routinely operate and maintain high temperature furnaces and image furnaces
- Sample preparation in glove box

# Curriculum Vitae of Biao Hu

## Materials Characterization

- Investigation of electrical, magnetic and thermodynamic properties based on **PPMS** and **MPMS** (Quantum Design)
- Powder X-ray and Neutron diffraction; Single-crystal X-ray diffraction structural refinements using SHELXL-97 and FullProf program
- Concentration analysis via inductively coupled plasma mass spectrometry (**ICP-MS**)
- Study sample surface topography and element analysis via **SEM & EDS**
- High-resolution TEM imaging and routine TEM specimen preparation
- Investigation of surface topography via Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy (AFM)
- Design and build new facility for *in situ* process on sample preparation in Ultra-high Vacuum (UHV) chamber
- Thin film growth on metal oxide surface using Pulsed Laser Deposition (PLD)
- Sample processing via Focused Ion Beam (FIB) technique
- Sample cleaning via sputter gun and coating process via ion beam sputtering (IBS)
- Electron-beam evaporation, Electrochemical etching

## COMPUTING SKILLS

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- Computer programming languages FORTRAN, C, perl, LabVIEW
- Engineering computing and designing using packages Matlab, AutoCAD
- Familiar with operation system Linux, Unix

## RESEARCH INTERESTS

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- Physics of complex electron systems in bulk and surface or interface: Strongly correlated transition metal oxides (colossal magnetoresistive manganites, high temperature superconductors, strontium ruthenates, cobalt oxides)
- Synthesis and characterization of low dimensional materials, nanostructures for technological application (green materials)
- Novel crystal growth and materials characterization methodology

## AWARDS AND HONORS

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|---|-----------------------------|-------------|
| • Ganesh Chanmugam Distinguished Dissertation Award | Louisiana State University  | 2012        |
| • Sigma Pi Sigma Inductees                          | The University of Tennessee | 2008        |
| • Excellent League Leader                           | Fudan University, China     | 2004        |
| • Academic Excellence Scholarship                   | Lanzhou University, China   | 1998 – 2000 |

## PROFESSIONAL SERVICES

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Refereeing for journal: Physical Review Letters; Physical Review B; Journal of Physics D: Applied Physics; Journal of Physics: Condensed Matter; Nanotechnology; Journal of Alloys and Compounds; International Journal of Modern Physics B

## PUBLICATIONS

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## Curriculum Vitae of Biao Hu

1. Keeseong Park, Bing Li, Despina Louca, **Biao Hu**, Jianshi Zhou, John B. Goodenough, “Local distortions and orbital ordering in YTiO<sub>3</sub>”, proceedings of the 19<sup>th</sup> International Conference on Magnetism 2012, Journal of the Korean Physical Society (Submitted)
2. **Biao Hu**, E. W. Plummer, and R. Jin, “Field-Induced Metallicity in Insulating Sr<sub>3</sub>(Ru<sub>1-x</sub>Mn<sub>x</sub>)<sub>2</sub>O<sub>7</sub>”, (To be submitted)
3. V. B. Nascimento, J. W. Freeland, **Biao Hu**, E. W. Plummer and R. Jin, “Element-resolved electronic and magnetic properties of Sr<sub>3</sub>(Ru<sub>1-x</sub>Mn<sub>x</sub>)<sub>2</sub>O<sub>7</sub>”, (To be submitted)
4. Dalgis Mesa, F. Ye, S. Chi, J. A. Fernandez-Baca, W. Tian, **Biao Hu**, R. Jin, E. W. Plummer and J. Zhang, “Single-bilayer *E*-type antiferromagnetism in Mn-substituted Sr<sub>3</sub>Ru<sub>2</sub>O<sub>7</sub>: Neutron scattering study”, *Physical Review B*(R) 85, 180410 (2012)
5. **Biao Hu**, Gregory T. McCandless, V. O. Garlea, S. Stadler, Yimin Xiong, Julia Y. Chan, E. W. Plummer, and R. Jin, “Structure-property coupling in Sr<sub>3</sub>(Ru<sub>1-x</sub>Mn<sub>x</sub>)<sub>2</sub>O<sub>7</sub>”, *Physical Review B*, 84, 174411 (2011)
6. **Biao Hu**, Gregory T. McCandless, Melissa Menard, V. B. Nascimento, Julia Y. Chan, E. W. Plummer, and R. Jin, “Surface and bulk structural properties of single-crystalline Sr<sub>3</sub>Ru<sub>2</sub>O<sub>7</sub>”, *Physical Review B*, 81, 184104 (2010)
7. Tae-Hwan Kim, M. Angst, **B. Hu**, R. Jin, X.-G. Zhang, J. F. Wendelken, E. W. Plummer, and An-Ping Li, “Imaging and manipulation of the competing electronic phases near the Mott metal-insulator transition”, *Proceedings of National Academy of Sciences*, 107, 5272-5275 (2010)
8. Haizhong Guo, Yi Li, Darwin Urbina, **Biao Hu**, Rongying Jin, Tijiang Liu, David Fobes, Zhiqiang Mao, E. W. Plummer, and Jiandi Zhang, “Doping and dimensionality effects on the core-level spectra of layered ruthenates”, *Physical Review B* 81, 155121 (2010)
9. F. C. Niestemski, Von Braun Nascimento, **Biao Hu**, Ward Plummer, J. Gillett, Suchitra Sebastian, Ziqiang Wang, V. Madhavan, “Unveiling the Atomic and Electronic Structure at the Surface of the Parent Pnictide SrFe<sub>2</sub>As<sub>2</sub>”, **arXiv**: 0906.2761
10. V. B. Nascimento, Ang Li, D. R. Jayasundara, Yi Xuan, J. O’Neal, Shuheng H. Pan, T. Y. Chien, **Biao Hu**, X. B. He, Guorong Li, A.S. Sefat, M.A. McGuire, B.C. Sales, D. Mandrus, M. H. Pan, Jiandi Zhang, R. Jin, E. W. Plummer, “Surface Geometric and Electronic Structure of BaFe<sub>2</sub>As<sub>2</sub>(001)”, *Physical Review Letters* 103, 076104 (2009)
11. Xiu-Fang Gong, **Biao Hu**, Xi-Jing Ning, and Jun Zhuang, “Decay mechanism of double-layer islands on close-packed surfaces: Silver on Ag(111) and copper on Cu(111)”, *Thin Solid Films*, Vol. 493, Issues 1-2, P146-151 (2005)
12. **Biao Hu**, Xiu-Fang Gong, Xi-Jing Ning, “Dynamical Behaviour of Ag and Cu Double-Layered Islands on fcc (111) Surfaces”, *Chinese Physics Letters*, Vol. 22, 427 (2005)

## PRESENTATIONS, POSTERS AND ABSTRACTS

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- **Biao Hu**, E. W. Plummer, R. Jin, “Suppression of an antiferromagnetic insulating phase in Sr<sub>3</sub>(Ru<sub>1-x</sub>Mn<sub>x</sub>)<sub>2</sub>O<sub>7</sub> by magnetic field”, American Physical Society March Meeting, February 27 – March 2, Boston, MA (2012)
- Jing Teng, Chen Chen, **Biao Hu**, Jiandi Zhang, Rongying Jin, E. W. Plummer, “Surface dynamics and electronic properties of parent and Mn doped Sr<sub>3</sub>Ru<sub>2</sub>O<sub>7</sub>”, American Physical Society March Meeting, February 27 – March 2, Boston, MA (2012)
- Ward Plummer, Guorong Li, Qing Li, Minghu Pan, **Biao Hu**, V. B. Nascimento, Jiandi Zhang, Rongying Jin, “STM study of the Mn-dopants on the Surface of Sr<sub>3</sub>(Ru<sub>1-x</sub>Mn<sub>x</sub>)<sub>2</sub>O<sub>7</sub> (*x* = 6%, 16%)”, American Physical Society March Meeting, February 27 – March 2, Boston, MA (2012)
- Dalgis Mesa, Feng Ye, Songxue Chi, Jaime A. Fernandez-Baca, V. O. Garlea, **Biao Hu**, Rongying Jin, E.

## Curriculum Vitae of Biao Hu

- W. Plummer, Jiandi Zhang, “Anomalous *E*-type antiferromagnetism in the ground state of Mn-substituted  $\text{Sr}_3\text{Ru}_2\text{O}_7$ ”, American Physical Society March Meeting, February 27 – March 2, Boston, MA (2012)
- **Biao Hu**, Gregory T. McCandless, V. O. Garlea, S. Stadler, E. W. Plummer, R. Jin, “Correlation between structural and magnetic properties in  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$  single crystals”, American Physical Society March Meeting, March 21 – 25, Dallas, TX (2011)
  - V. B. Nascimento, J. W. Freeland, **Biao Hu**, R. Jin, E. W. Plummer, “Element-resolved electronic and magnetic properties of  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$ ”, American Physical Society March Meeting, March 21 – 25, Dallas, TX (2011)
  - **Biao Hu**, Gregory T. McCandless, E. W. Plummer, R. Jin, “Doping dependence of physical, electrical and magnetic properties of  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$  single crystals”, 77th Annual Meeting of the Southeastern Section of American Physical Society, October 20 – 23, Baton Rouge, LA (2010)
  - **Biao Hu**, Gregory T. McCandless, E. W. Plummer, R. Jin, “Evolution of physical properties with Mn content in  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$  single crystals”, American Physical Society March Meeting, March 15 – 19, Portland, OR (2010)
  - V. B. Nascimento, **Biao Hu**, Rongying Jin, E. W. Plummer, “The structure of the (001) surface of  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$ ”, American Physical Society March Meeting, March 15 – 19, Portland, OR (2010)
  - **Biao Hu**, V. B. Nascimento, R. Jin, E. W. Plummer, Minghu Pan, An-ping Li, David Mandrus, Shuheng Pan, “Structural analysis of the surface of bilayered ruthenate  $\text{Sr}_3\text{Ru}_2\text{O}_7$ ”, American Physical Society March Meeting, March 16 – 20, Pittsburg, PA (2009)
  - Teyu Chien, **Biao Hu**, Shuheng Pan, V. B. Nascimento, E. W. Plummer, “LEED structural analysis of strongly correlated systems: reaching the limit of the instrumentation?”, American Physical Society March Meeting, March 16 – 20, Pittsburg, PA (2009)
  - Haizhong Guo, Yi Li, **Biao Hu**, Rongying Jin, E. W. Plummer, Jiandi Zhang, D. Urbina, Tijiang Liu, David Fobes, Zhiqiang Mao, “Dimensionality and doping effect on the core-level X-ray photoemission satellites in layered ruthenates”, American Physical Society March Meeting, March 16 – 20, Pittsburg, PA (2009)
  - Tae-Hwan Kim, M. Angst, R. Jin, X. G. Zhang, J. F. Wendelken, A. P. Li, **B. Hu**, E. W. Plummer, “Real-space imaging of electronic phase separation in a Mn-doped bilayered ruthenate”, American Physical Society March Meeting, March 16 – 20, Pittsburg, PA (2009)
  - V. B. Nascimento, X. B. He, R. Jin, E. W. Plummer, T. Y. Chien, **Biao Hu**, Guorong Li, M. H. Pan, J. F. Wendelken, A. S. Sefat, M. A. McGuire, B. C. Sales, D. Mandrus, Ang Li, D. R. Jayasundra, Yi Xuan, J. O’Neal, Shuheng Pan, “Structural investigation of the  $\text{BaFe}_2\text{As}_2(001)$  surface using LEED and STM”, American Physical Society March Meeting, March 16 – 20, Pittsburg, PA (2009)
  - **Biao Hu**, V. B. Nascimento, R. Jin, E. W. Plummer, Manuel Angst, Ovidiu Garlea, David Mandrus, “Doping-induced structural and physical properties changes in  $\text{Sr}_3(\text{Ru}_{1-x}\text{Mn}_x)_2\text{O}_7$  ( $0 \leq x \leq 0.2$ ) single crystals”, American Physical Society March Meeting, March 10 – 14, New Orleans, LA (2008)
  - Xiu-Fang Gong, **Biao Hu**, Xi-Jing Ning, “Decay mechanism of double-layer Cu/Ag islands on Cu/Ag(111) surfaces”, Poster on International Conference on Physics Education & Frontier Research in the 4th OCPA Joint Meeting of Chinese Physicists World-Wide, Shanghai, China Jun 28 - Jul 1, 2004

## REFERENCES

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