

Lei Bi

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EDUCATION

- Sep, 2006 – present: Massachusetts Institute of Technology, Cambridge, MA
Ph.D Candidate
Department of Materials Science and Engineering (DMSE)
Research field: Magneto-optical Materials and Devices for On-chip
Integrated Optical Isolator Applications
Supervisor: Professor Caroline A Ross, Dept. of MSE, MIT
Area of Expertise: Magnetic Oxides and Photonic Devices
- Sep, 2004 – Jul. 2006: Tsinghua University, Beijing, P.R.China
Master of Science, Major in Materials Physics and Chemistry
Department of Materials Science and Engineering (MSE)
Research field: Research on Si Based Light Emission Materials
- Sep, 2000 – Jul, 2004: Tsinghua University, Beijing, P.R.China
B.S. student of Materials Science and Engineering (MSE)
Department of Materials Science and Engineering (MSE)
Date of Graduation: 07/2004

SKILLS

Bulk Material Fabrication: Ceramic Powder Fabrication Techniques: Ball Milling, Calcination, Ceramic Target Fabrication: Cold Isostatic Pressing, Sintering

Thin Film and Microfabrication Techniques: Sputtering, Ion Implantation, Rapid Thermal Annealing, Pulsed Laser Deposition, Electron-beam Evaporation, Thermal Evaporation, Optical Lithography, E-beam Lithography, Plasma Etching, Lift-off

Analysis Methods (hands-on experience): 1D and 2D X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Energy Dispersive Spectroscopy (EDS), Wavelength Dispersive Spectroscopy (WDS), Micro-Raman Measurements, Photoluminescence (PL), Fourier Transform Infrared Spectroscopy (FTIR), Ultraviolet-Visible-Near infrared Spectroscopy, Vibrating Sample Magnetometry (VSM), Alternating Gradient Magnetometry (AGM), Atomic Force Microscopy (AFM), Magnetic Force Microscopy (MFM), Probe Station/Electrical Measurements, Hall Effect Measurements, Thin Film and Crystal Based Magneto-optical Measurements, Waveguide Transmittance Related Characterization, Optical Resonator Characterization, Profilometry, Ellipsometry

Other Familiar Analysis Methods: Auger Electron Spectroscopy (AES), X-ray Photoelectron Spectroscopy (XPS), Rutherford Backscattering Spectroscopy (RBS), X-ray Absorption Near Edge Structure (XANES), Extended X-ray Absorption Fine Structure (EXAFS)

Theoretical Simulation: VASP (First Principle Simulation Tool for Materials Science), C, FORTRAN, Matlab, Mathematica, Materials Studio, Film Mode Matching, Beam Propagation Method

HONORS & AWARDS

Intel Ph.D. Fellowship for the 2010-2011 Academic Year	2010
Newport Spectra-Physics Research Excellence Award	2010
Tsinghua-Chenzhifu Scholarship for Academic Distinction	2002, 2003

RESEARCH EXPERIENCE

Sep, 2006 – present

Ph. D. Candidate

Massachusetts Institute of Technology, Cambridge, MA

Research on Novel Magneto-optical Materials for On-chip Optical Isolators

- Experimental study of the magnetic and optical properties of BiFeO_3 and $\text{Bi}_2(\text{FeMn})\text{O}_6$ epitaxial thin films. Simulation of the B site ordering in $\text{Bi}_2(\text{FeMn})\text{O}_6$ perovskite by *ab-initio* calculations.
- Fabrication of room temperature ferromagnetic $\text{Ce}_{1-x}\text{Co}_x\text{O}_2$ thin film and characterization of its optical and magneto-optical property.
- Investigation of self-assembled nanopillar structures in epitaxial LaFeO_3 films.
- Experimental characterization of the magnetic, magneto-optical properties and silicon integration of $\text{Sr}(\text{Ti}_{1-x}\text{Co}_x)\text{O}_3$ and $\text{Sr}(\text{Ti}_{1-x}\text{Fe}_x)\text{O}_3$ epitaxial thin films.
- Control and optimization of the magnetic, magneto-optical and optical properties of $\text{Sr}(\text{Ti}_{0.6}\text{Fe}_{0.4})\text{O}_3$ films by material defect chemistry design.

Research on Integrated Nonreciprocal Photonic Devices

- Theoretical simulation of the optical transmission and non-reciprocal phase shift in magnetic oxide based strip-loaded waveguides.
- Integration and simulation of $\text{As}_2\text{S}_3/\text{Sr}(\text{Ti}_{1-x}\text{Fe}_x)\text{O}_3$ $\text{As}_2\text{S}_3/\text{Sr}(\text{Ti}_{1-x}\text{Co}_x)\text{O}_3$ strip-loaded waveguides for integrated magneto-optical isolators.
- Monolithic integration of Si/yttrium iron garnet and chalcogenide glass/yttrium iron garnet strip-loaded waveguides for on-chip non-reciprocal photonic devices.
- Monolithic integration of bismuth doped yttrium iron garnet on an SOI platform and demonstration of optical isolation in a non-reciprocal optical resonator structure.

Sep, 2004 – Jul, 2006

Graduate Student Project

Tsinghua University, Beijing, China

- Study of the effect of post annealing in O_2 on the structure and PL properties of Si rich SiO_2 films.
- Experimental study of the structure and photoluminescence properties of silicon rich Al_2O_3 films.
- Research on nickel-induced phase separation in SiO_x films during rapid thermal annealing.
- Theoretical investigation of Ni induced phase separation by thermodynamic and kinetic models.

Jan, 2004 – Jul, 2004

Diploma Project

Tsinghua University, Beijing, China

- Synthesis of silicon rich SiO_2 films by reactive rf-sputtering and high temperature annealing.
- Investigation of the relationship between micro-structure and PL properties in Si rich SiO_2 .

Sep, 2001 – Oct, 2002

Student Research Program

Tsinghua University, Beijing, China

- Fabrication of long persistence photoluminescence phosphor $\text{SrAl}_2\text{O}_4:\text{Eu}$ by employing the self-propagating high-temperature synthesis method.

PUBLICATIONS

1. H. S. Kim, **L. Bi**, H. Park, Y. Chang, D. Yang, G. F. Dionne and C. A. Ross
Self-assembled Single-Phase Perovskite Nanocomposite Thin films
Nano Letters **10** 597 (2010)
2. **L. Bi**, J. Hu, L. C. Kimerling and C. A. Ross
Fabrication and characterization of $\text{As}_2\text{S}_3/\text{Y}_3\text{Fe}_5\text{O}_{12}$ and $\text{Y}_3\text{Fe}_5\text{O}_{12}/\text{SOI}$ strip-loaded waveguides for integrated optical isolator applications
Proc. SPIE **7604** 760406 (2010)
3. **L. Bi**, H. S. Kim, G. F. Dionne and C. A. Ross
Structure, magnetic properties and magnetoelastic anisotropy in epitaxial $\text{Sr}(\text{Ti}_{1-x}\text{Co}_x)\text{O}_3$ films
New Journal of Physics **12** 043044 (2010)
4. **L. Bi**, H. S. Kim, J. Hu, L. C. Kimerling and C. A. Ross
 $\text{As}_2\text{S}_3/\text{Sr}(\text{Ti}_{0.7}\text{Co}_{0.3})\text{O}_3$ and $\text{As}_2\text{S}_3/\text{Sr}(\text{Ti}_{0.6}\text{Fe}_{0.4})\text{O}_3$ strip-loaded waveguides for integrated magneto-optical isolator applications
Proc. SPIE **7218** 721803 (2009)
5. **L. Bi**, H. S. Kim, G. F. Dionne, C. A. Ross, H. J. Paik and Y. C. Park
Orientation control and self-assembled nano-pyramid structure of LaFeO_3 films epitaxially grown on $\text{SrTiO}_3(001)$ substrates
Applied Physics Letters **95** 121908 (2009)
6. H. S. Kim, **L. Bi**, G. F. Dionne, C. A. Ross, H. J. Paik
Structure, magnetic and optical properties, and Hall effect of Co- and Fe-doped SnO_2 films
Physical Review B **77** 214436 (2008)
7. **L. Bi**, H. S. Kim, G. F. Dionne, S. A. Speakman, D. Bono, C. A. Ross
Structural, magnetic, and magneto-optical properties of Co-doped $\text{CeO}_{2-\delta}$ films
Journal of Applied Physics **103** 07D138 (2008)
8. H. S. Kim, **L. Bi**, G. F. Dionne, C. A. Ross
Magnetic and magneto-optical properties of Fe-doped SrTiO_3 films
Applied Physics Letters **93** 092506 (2008)
9. **L. Bi**, A. R. Taussig, H. S. Kim, L. Wang, G. F. Dionne, D. Bono, K. Persson, G. Ceder and C. A. Ross
Structural, magnetic, and optical properties of BiFeO_3 and $\text{Bi}_2\text{FeMnO}_6$ epitaxial thin films: An experimental and first-principles study
Physical Review B **78** 104106 (2008)
10. C. Ma, **L. Bi** and J. Y. Feng
Tin-induced enhancement of photoluminescence and crystal growth in Si-rich silica films
Journal of Crystal Growth **305** 30 (2007)
11. **L. Bi** and J. Y. Feng
Nanocrystal and interface defects related photoluminescence in silicon-rich Al_2O_3 films
Journal of Luminescence **121** 95 (2006)
12. **L. Bi**, Y. He and J. Y. Feng
Nickel induced phase separation and nanocrystal growth in Si-rich silica films
Nanotechnology **17** 2289 (2006)
13. Y. He, **L. Bi**, J. Y. Feng and Q. L. Wu
A study of the correlation between ultraviolet and infrared emission in Ni-doped SiO_x films
Journal of Physics D: Applied Physics **39** 449 (2006)
14. Y. He, K. Ma, **L. Bi** and J. Y. Feng

Nickel induced enhancement of photoluminescence from Si-rich silica films

Applied Physics Letters **88** 031905 (2006)

15. **L. Bi**, Y. He and J. Y. Feng

Effect of post-annealing in oxygen atmosphere on the photoluminescence properties of Si rich SiO₂ films

Journal of Crystal Growth **289** 564 (2006)

16. Y. He, **L. Bi** and J. Y. Feng

Properties of Si-rich SiO₂ films by RF magnetron sputtering

Journal of Crystal Growth **280** 352 (2005)

PRESENTATIONS

1. **L. Bi**, H. S. Kim, G. F. Dionne and C. A. Ross

Magneto-optical properties and magnetic anisotropy of Sr(Ti_{1-x}Co_x)O₃ and Sr(Ti_{1-x}Fe_x)O₃ films

11th Joint MMM–Intermag Conference, Washington, DC (2010)

2. **L. Bi**, H. S. Kim, J. Hu, L. C. Kimerling and C. A. Ross

As₂S₃/Sr(Ti_{0.6}Fe_{0.4})O₃ and As₂S₃/Sr(Ti_{0.7}Co_{0.3})O₃ strip-loaded waveguides for integrated magneto-optical isolator applications

SPIE Photonics West Conference, San Jose, CA (2009)

3. **L. Bi**, H. S. Kim, G. F. Dionne and C. A. Ross

Room temperature ferromagnetism and silicon integration of Sr(Ti_{1-x}Co_x)O₃ epitaxial films

Materials Research Society Fall Meeting, Boston, MA (2009)

4. **L. Bi**, H. S. Kim, G. F. Dionne and C. A. Ross

Epitaxial growth of LaFeO₃ films on SrTiO₃ (001) substrates with controllable crystallographic orientations

Materials Research Society Fall Meeting, Boston, MA (2008)

5. **L. Bi**, H. S. Kim, G. F. Dionne, S. A. Speakman, D. Bono and C. A. Ross

Co doped CeO_{2-δ} films for silicon compatible optical isolator applications

52nd Conference on Magnetism and Magnetic Materials, Tampa, FL (2007)

6. **L. Bi**, A. R. Taussig, H. S. Kim, G. F. Dionne, D. Bono and C. A. Ross

Growth and characterization of BiFeO₃ and Bi(Fe_{0.5}Mn_{0.5})O₃ films (M=Mn, Ni or Co)

Materials Research Society Fall Meeting, Boston, MA (2007)

PATENTS

U. S. Patent Application Ser. No. 12/262,739, Magnetic material for magneto-optical isolator, pending

U. S. Patent Application Ser. No. 12/406,313, Integrated Si/SiGe magneto-optic isolator, pending

Patterned Non-reciprocal Optical Resonator for Integrated Optical Isolators, submitted

LEADERSHIP ACTIVITIES

Sept., 2004 – Jul. 2006

Commissary in charge of organization of Class Materials Graduate 42

May, 2008 – May, 2009

Vice president, Chinese Student and Scholars Association (CSSA) of MIT

Mar., 2010

Organizer, Electric Vehicle Panel, 2010 MIT Energy Conference