SHENG TONG

Nanoscience and Technology Division, Argonne National Laboratory

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EDUCATION

Ph.D., Materials Science — Dec 2012

University of Cincinnati

Dissertation: "Dielectric and ferroelectric properties of lead lanthanum zirconate titanate thin films for capacitive energy storage"

M.S., Microelectronic Engineering — June 2007

South China University of Technology

Dissertation: "Effects of Sb_2O_5 and La_2O_3 dopants on the dielectric and piezoelectric properties of $Pb(Zr,Ti)O_3$ ceramics"

B.S., Electrical Engineering — June 2004

South China University of Technology

RESEARCH EXPERIENCE

Postdoctoral Associate — Dec 2012 – present

Argonne National Laboratory

Thin Films of Functional Complex Oxide Materials and Their Electronic Structure

- Deposited of complex oxides and interfaces using molecular beam epitaxy (MBE) and sputtering.
- Collaborated in fabricating self-assembled free-standing ferroelectric thin films.
- Characterized thin films using scanning probe microscopy.

Research Assistant — Sep 2007 – Nov 2012

Argonne National Laboratory & University of Cincinnati

High Dielectric Constant Capacitors for Hybrid Electric Vehicle Power Inverters

- Developed lanthanum doped lead zirconate titanate (PZT) thin films using sol-gel deposition with dielectric constant (~1400), dc dielectric breakdown strength (~2 MV/cm), energy density (~40 J/cc) and energy efficiency (~80%).

Research Assistant — Sep 2004 – Jun 2007

South China University of Technology

High Electrostrictive Piezoelectric Ceramic Actuator

- Developed high permittivity, piezoelectric coefficient Sb and La co-doped PZT ceramics with d_{33} ~680 pC/N, k_p ~0.7, permittivity ~3900.

High Mechanical Quality Factor "Hard" PZT for Igniter Application

- Enhanced electric output, and improved electric efficiency of "hard" PZT piezoelectric igniter, using nano/micro-sized alumina and antimony doping, with d_{33} ~200 pC/N, k_p ~0.9

PZN-PZT Composition Optimization for Improved Piezoelectric Properties

- Synthesized ceramics using two-step sintering method, and mapped phase diagram of $Pb(Zn_{1/3}Nb_{2/3})O_3$ - PZT ferroelectric ceramics to enhance piezoelectric properties for actuator application.

Research Intern — Mar 2003 – Jul 2003

Fenghua Advanced Technology Holding Co., Ltd

- Assisted researchers in optimizing processing conditions of multiplayer ceramic capacitors (MLCCs) and thick-film hybrid printing circuits.

TEACHING EXPERIENCE

Teaching Assistant Jan 2013 – May 2013

University of Illinois at Chicago

- Graded "Electrodynamics and Its Application" (PHYS594) course assignments, answering questions, and counseling students.

Teaching Assistant Sep 2007 – Jun 2008

University of Cincinnati

- Sole responsibility for "Metallurgy Laboratory" course in six metal labs, including coordinating lab instruction, lab demonstrations and assisting students with questions, design assistance, etc.
- Graded "Introduction to Materials Engineering" course assignments, performed experiments demonstrating fundamental materials principles and led discussion

Undergraduate Mentor Sep 2006 – Jun 2007

South China University of Technology

- Advised and mentoring undergraduates as they work toward the completion of the thesis based on traditional ceramics synthesis and capacitor fabrication.

High School Tutor Apr 2003 – Jun 2007

South China University of Technology

- Taught high school students physics, chemistry and mathematics.

REFEREED JOURNAL PUBLICATIONS

1. **S. Tong**, B. Ma, M. Narayanan, S. Liu, U. Balachandran, D. Shi, "Dielectric behavior of lead lanthanum zirconate titanate thin films deposited on different electrodes/substrates", *Mater. Lett.* DOI: 10.1016/j.matlet.2013.05.068 (2013)
2. **S. Tong**, M. Narayanan, B. Ma, S. Liu, R. Koritala, U. Balachandran, D. Shi, "Effect of Lanthanum Content and Substrate Strain on Structural and Electrical Properties of PLZT Thin Films", *Mater. Chem. Phys.,* **140**, 427 (2013)
3. **S. Tong**, B. Ma, M. Narayanan, S. Liu, R. Koritala, U. Balachandran, D. Shi, "PLZT Ceramic Thin Films for Energy Storage", *ACS Appl. Mater. Inter*., **5**, 1474 (2013)
4. **S. Tong**, M. Narayanan, B. Ma, R. Koritala, S. Liu, U. Balachandran, D. Shi, "Effect of dead layer and strain on the diffuse phase transition of PLZT relaxor thin films", *Act. Mater*., **59**, 1309 (2011).
5. M. Naryanana, **S. Tong**, S. Liu, B. Ma, U. Balachandran, "Estimation of intrinsic contribution to dielectric response of PLZT thin films at low frequencies using high bias fields", *Appl. Phys. Lett.,* **102**, 062906 (2013)
6. M. Narayanan**, S. Tong**, B. Ma, S. Liu, U. Balachandran, "Modified Johnson model for ferroelectric PLZT at very high fields and below Curie temperature", *Appl. Phys. Lett*., **100**, 022907 (2012)
7. M. Narayanan, **S. Tong**, R. Koritala, B. Ma, V. Pol, U. Balachandran, "Sol-Gel Synthesis of High-Quality $SrRuO_3$ Thin-Film Electrodes Suppressing the Formation of Detrimental RuO_2 and the Dielectric Properties of Integrated PLZT Films", *Chem. Mater*., **23**, 106 (2011).
8. B. Ma, **S. Tong**, M. Narayanan, S. Liu, S. Chao, U. Balachandran, "Fabrication and dielectric property of ferroelectric PLZT films grown on metal foils", *Mater. Res. Bull*., 46, 1124 (2011).
9. B. Ma, S. Liu, **S. Tong**, M. Narayanan, R. Koritala, Z. Hu, U. Balachandran, "Residual Stress of PLZT Films Grown by Sol-gel Process", *Smart Mater. Struct.* **22**, 055019 (2013)
10. M. Narayanan, B. Ma, **S. Tong**, U. Balachandran, R. Koritala "Electrical Properties of PLZT Thin Films Grown on $SrRuO_3$ Buffered Nickel and Silicon Substrates by Chemical Solution Deposition", *Int. J. Appl. Ceram. Technol*., **9**, 45 (2012).
11. B. Ma, S. Liu, **S. Tong**, M. Narayanan, U. Balachandran, "Enhanced dielectric properties of PLZT films with compressive stress", *J. Appl. Phys.*, **112**, 114117 (2012).
12. B. Ma, M. Narayanan, **S. Tong**, U. Balachandran, "Fabrication and characterization of ferroelectric PLZT film capacitors on metallic substrates", *J. Mater. Sci*., **45**, 151 (2010).
13. B. Ma, M. Narayanan, S. Liu, **S. Tong**, U. Balachandran, "Development of high dielectric strength ceramic film capacitors for advanced power electronics", *J. Microelectro. Electro. Pack.* **10**, 1 (2013)

14. B. Ma, Z. Hu, S. Liu, **S. Tong**, M. Narayanan, R. Koritala, U. Balachandran, "Temperature-Dependent Dielectric Nonlinearity of Relaxor Ferroelectric $Pb_{0.92}La_{0.08}Zr_{0.52}Ti_{0.48}O_3$ Thin Films", *Appl. Phys. Lett.* **102**, 202901 (2013)
15. S. Liu, B. Ma, M. Narayanan, **S. Tong**, R. Koritala, Z. Hu, U. Balachandran, "Dielectric spectroscopy of PLZT thin films with and without ZrO_2 insertion layers", *J. Appl. Phys.* **113**, 147107 (2013)
16. S. Liu, B. Ma, M. Narayanan, **S. Tong**, R. Koritala, U. Balachandran, "Microstructure and electrical properties of $LaNiO_3$ thin films by RF sputtering for the growth of $(Pb,La)(Zr,Ti)O_3$ films on silicon and nickel substrates", *J. Vacc. Sci. Tech. A,* **30**, 061505 (2012)
17. M. Narayanan, M. Pan, S. Liu, **S. Tong**, S. Hong, B. Ma, U. Balachandran, "Effect of stress state on the domain configuration and switching behavior in ferroelectric thin films", *RSC Adv.*, **2**, 11901 (2012)
18. B. Ma, S. Chao, M. Narayana, S. Liu, **S. Tong**, R. Koritala, U. Balachandran, "Dense PLZT films grown on nickel substrates by PVP-modified sol–gel method", *J. Mater. Sci.* **48**, 1180 (2013)
19. M. Narayanan, U. Balachandran, S. Stoupin, B. Ma, **S. Tong**, S. Chao, S. Liu, "Dielectric properties and spectroscopy of large-aspect-ratio ferroelectric thin-film heterostructures", *J. Phys. D*, **45**, 335401 (2012)

PRESENTATIONS AND POSTORS

1. **S. Tong**, "PLZT relaxor ferroelectric thin film capacitors for energy storage", Center for Nanoscale Materials, Argonne National Laboratory, Argonne, IL (2012)
2. **S. Tong**, B. Ma, M. Narayanan, S. Liu, U. Balachandran, "Bottom-electrode Assisted Sintering in PLZT Thin Films", 4th International Congress on Ceramics, Chicago, IL (2012)
3. **S. Tong**, B. Ma, M. Narayanan, U. Balachandran, "Revised Diffuse Phase Transition Law of Relaxor Thin Films for Energy Storage Application", Electronic Materials and Applications 2011, Orlando, FL (2011)
4. S. Liu, B. Ma, M. Narayanan, **S. Tong**, U. Balachandran, "Microstructure and electrical properties of $LaNiO_3$ thin films formed by RF sputtering for the growth of PLZT on silicon and nickel substrates", 4th International Congress on Ceramics, Chicago, IL (2012)
5. B. Ma, M. Narayanan, S. Liu, **S. Tong**, U. Balachandarn, "Development of high-dielectric-strength ceramic film capacitors for advanced power electronics", 45th International Symposium on Microelectronics, San Diego, CA (2012)
6. M. Narayanan, B. Ma, R. Koritala, **S. Tong**, U. Balachandran, "Chemical Solution Deposition of High-quality SrRuO3 thin Film Electrodes and the Dielectric Properties of Integrated PLZT", IMAPS/ACerS 7th International Conference and Exhibition, San Diego, CA (2011)
7. U. Balachandran, B. Ma, M. Narayanan, **S. Tong**, S. E. Dorris, "High-dielectric-constant capacitors for power electronic systems", 2010 DOE Vehicle Hydrogen Program and Vehicle Technologies Program Annual Merit Review & Peer Evaluation Meeting, Washington, DC (2010)
8. U. Balachandran, B. Ma, M. Narayanan, **S. Tong**, S. E. Dorris, "High-dielectric-constant-ceramic capacitors for power inverters in hybrid electric vehicles", International Conference on Advanced Functional Materials and 73rd Annual Session of the Indian Ceramic Society, Trivandrum, India (2009)
9. U. Balachandran, B. Ma, M. Narayanan, **S. Tong**, S. E. Dorris, M. Lanagan, "High-dielectric-constant capacitors for power electronic systems", DOE Vehicle Technologies Program – Advanced Power Electronics and Electric Motors R&D, FY10 Kickoff Meeting, Knoxville, TN (2009)
10. S. Liu, B. Ma, R. Koritala, M. Narayanan, **S. Tong**, U. Balachandran, "Structural and Electrical Properties of $LaNiO_3$ Thin Films by RF Sputtering for the Growth of PLZT on Metal Foils", 2012 APS/CNM/EMC user meeting, Argonne, IL (2012)
11. U. Balachandran, B. Ma, M. Narayanan, S. Liu, **S. Tong**, T. Lee, S. E. Dorris, "High-dielectric-constant capacitors for power electronic systems", 2012 DOE Hydrogen and Fuel Cells and Vehicle Technologies Annual Merit Review and Peer Evaluation Meeting, Arlington, VA (2012)
12. B. Ma, M. Narayanan, S. Liu, S. Chao, **S. Tong**, U. Balachandran, "Ferroelectric PLZT Films Grown on Metal Foils by Chemical Solution Deposition", Fundamental Physics of Ferroelectrics and Related Materials 2012, Argonne, IL (2012)

13. U. Balachandran, B. Ma, M. Narayanan, S. Liu, S. Chao, **S. Tong**, S. E. Dorris, "High-dielectric-constant capacitors for power electronic systems", 2011 DOE Vehicle Technologies Program Annual Merit Review & Peer Evaluation Meeting, Washington, DC (2011)
14. U. Balachandran, B. Ma, M. Narayanan, S. Liu, S. Chao, **S. Tong**, S. E. Dorris, "High-dielectric-constant capacitors for power electronic systems", DOE Vehicle Technologies Program – Advanced Power Electronics and Electric Motors R&D, FY12 Kickoff Meeting, Oak Ridge, TN (2011)
15. U. Balachandran, B. Ma, M. Narayanan, S. Liu, S. Chao, **S. Tong**, S. E. Dorris, "High-dielectric-constant capacitors for power electronic systems", DOE Vehicle Technologies Program – Advanced Power Electronics and Electric Motors R&D, FY11 Kickoff Meeting, Oak Ridge, TN (2010)

PROFESSIONAL ASSOCIATION AND ACTIVITIES

- Member of American Physical Society, American Ceramic Society, ASM International
- Peer reviewer of manuscripts for:
  - *Computational Materials Science*
  - *International Journal of Molecular Sciences*
  - *International Journal of Applied Ceramic Technology*
  - *Journal of Applied Physics*
  - *Journal of Materials Science*
  - *Journal of Micromechanics and Microengineering*
  - *Journal of Physics D: Applied Physics*
  - *Materials Science and Engineering B*
  - *Materials Science and Engineering C*
  - *Nano Life*
  - *Physica Scripta*
  - *Review of Scientific Instruments*
  - *Semiconductor Science and Technology*
  - *Thin Solid Films*
- Expert-Reviewer for project proposals/research programs of Joint Applied Research Projects (PCCA) for Romania National Council for Development and Innovation.
- Subject Matter Expert (SME) reviewer for proposals submitted to the Director's Competitive Grants component of the Laboratory Directed Research & Development (LDRD) Program.

AWARDS AND HONORS

- Forum on Graduate Student Affairs Travel Award — June 2012
  American Physical Society
- 4th International Congress on Ceramics Scholar — Sep 2012
  National Science Foundation
- Graduate Student Government Association Travel Grant — Jul 2012
  University of Cincinnati
- University Graduate Scholarship — Sep 2007– Aug 2012
  University of Cincinnati
- China-America Academic Exchange Scholarship — Sep 2007 – Apr 2009
  USA China Law Group, CA
- Outstanding Undergraduate Thesis Award — Jun 2004
  South China University of Technology