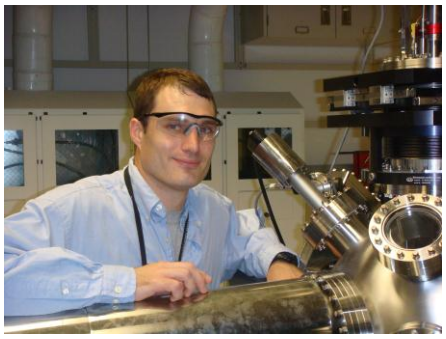
Michael D. Biegalski

R&D Staff
Functional Hybrid Nanostructures Group
Center for Nanophase Materials Sciences
Oak Ridge National Laboratory
(865) 574-5888
biegalskim@ornl.gov



Education

University of Illinois	Ceramic Engineering	B.S., 1998
Pennsylvania State University	Ceramic Engineering	M.S., 2001
Pennsylvania State University	Material Sciences & Engineering	Ph.D., 2006

Professional Experience

2008–p	Research and Development Staff Member, Center for Nanophase Materials Sciences (CNMS), Oak Ridge National Laboratory (ORNL)
2006–2008	Postdoctoral Research Associate, CNMS, ORNL
1997	Research Assistant, Ceramic Composites, Inc., Annapolis, Maryland

Professional and Synergistic Activities

2009	Student Speaking Competition Judge, Material Research Society
2009	Guest Lecturer, ORNL Introduction to Nano Science Lecture Series
2006–p	Reviewer, *Applied Physics Letters, Journal of Applied Physics, Thin Solid Films, Journal of Physics D, Journal of Magnetic Materials, Physical Review B, and Physical Review Letters*
1999–p	Member, Materials Research Society

Honors and Awards

2005	Best Poster Award Nomination, Materials Research Society Fall Meeting
1998; 1996	3M Scholarship, Material Science and Engineering, University of Illinois
1998	Alfred W. Allen Award for Academic Achievement, University of Illinois

Recent Invited talks and Contributed Conference Presentations (Invited Talks*****)

"Interface Magnetic Property Engineering through Control of the Octahedral Tilts in Lanthanum-Strontium Cobaltite," Electronic Material and Applications 2012, Orlando, FL, Jan. 18-20, 2012.*****

"The Oxide Material Effort at the Center for Nanophase Materials Science," 15th U.S.-Japan Seminar on Dielectric and Piezoelectric Ceramics, Kagashima, Japan, Nov. 6-9, 2011.*****

"Control of the Octahedral Tilts and the Impact on Magnetic Properties," 18th Workshop on Oxide Electronics, Napa, CA, Sept. 26-28, 2011.

"Control of the Octahedral Tilts in Lanthanum Strontium Cobaltite," 2011 Materials Research Society Spring Meeting, San Francisco, CA, Apr. 25-29, 2011.

"Low Temperature Ferroelectric and Strain Behavior of Bismuth Ferrite Thin Films," 14th U.S.-Japan Seminar on Dielectric and Piezoelectric Ceramics, Welches, OR, Oct. 11-14, 2009**.**

"Using Piezoelectric Substrates to Apply Uniform Reversible Strain to Epitaxial Oxide Films," 16th International Workshop on Oxide Electronics, Tarragona, Spain, Oct. 4-7, 2009.

"Enhancing Ferroelectricity Using Strain," Materials Science and Technology Conference at the Cinergy Center, Cincinnati, OH, Oct. 15-19, 2006.*

Publications (Over 45 publications in refereed journals, cited > 900 times) *Full publication list follows CV*

Research Synopsis

1. ***Synthesis of Thin Film Growth of Oxide Heterostructures.***
   Study of how to create oxide based materials using physical deposition methods with atomic level control and *in-situ* monitoring techniques to alter material structure and properties using epitaxy and chemical controls. Structures are characterized using x-ray and electron diffraction techniques.

2. ***Interfacial Effects on Magnetic Properties of Materials.***
   Characterization of magnetic properties of thin films using bulk and neutron techniques to determine how the interfaces between magnetic materials change the properties of thin films in single interfaces and superlattice structures consisting of hundreds of interfaces.

3. ***Electrochemical Strain Effects on Properties of Materials.***
   Fabrication and study of thin film architectures of oxide materials that enable the reversible control of oxygen migration and strain across an interface to explore the impact of strain and oxygen motion in materials on bulk properties and structure of materials.

Collaborations

A. Borisevich (ORNL); E. Arenholz (Lawrence Berkley National Laboratory); A. Baddorf (ORNL); L. Q. Chen (Pennsylvania State Univ.); K. Dorr (Univ. of Halle); C. B. Eom (Univ. of Wisconsin); D. Fong (Argonne National Laboratory); V. Gopalan (Pennsylvania State Univ.); S. Kalinin (ORNL); D. H. Kim (Tulane Univ.); V. Lauter (ORNL); J. Levy (Univ. of Pittsburg); P. Maksymovych (ORNL); B. Noheda (Univ. of Groningen); X. Q. Pan (Michigan State Univ.); D. G. Schlom (Cornell Univ.); Y. Shao-Horn (Mass. Inst. of Tech.); S. K. Streiffer (Argonne National Laboratory); S. Trolier-Mckinstry (Penn. State Univ.); Y. Takamura (Univ. of CA-Davis); M. A. Zurbachen (Univ. of CA-Los Angeles)

Graduate and Postdoctoral Advisors:

Postdoctoral Advisor: H. Christen (ORNL)
Graduate Advisors (Ph.D.): S. Trollier-McKinstry (Pennsylvania State University)
D. Schlom (Cornell University)
Graduate Advisor (M.S.): S. Trollier-McKinstry (Pennsylvania State University)

Graduate Students and Postdoctoral Advisees:

Postdoctoral: L. Qiao (Oak Ridge National Laboratory)

PUBLICATIONS

Michael D. Biegalski
Center for Nanophase Materials Sciences Division
Oak Ridge National Laboratory
Oak Ridge, TN 37831
biegalskim@ornl.gov

Publications *(Over 45 publications in refereed journals, cited > 900 times):*

M. D. Biegalski, D. H. Kim, S. Choudhury, L. Q. Chen, H. M. Christen, and K. Dorr, "Strong Strain Dependence of Ferroelectric Coercivity in a $BiFeO_3$ Film," *Applied Physics Letters* **98**(14), 142902 (2011).

C. J. C. Bennett, H. S. Kim, M. Varela, M. D. Biegalski, D. H. Kim, D. P. Norton, H. M. Meyer, and H. M. Christen, "Compositional Tuning of the Strain-induced Structural Phase Transition and of Ferromagnetism in $Bi_{1-x}Ba_xFeO_{3-\delta}$," *Journal of Materials Research* **26**(10), 1326 (2011).

M. C. Dekker, A. Herklotz, L. Schultz, M. Reibold, K. Vogel, M. D. Biegalski, H. M. Christen, and K. Dorr, "Magnetoelastic Response of $La_{0.7}Sr_{0.3}MnO_3/SrTiO_3$ Superlattices to Reversible Strain," *Physical Review B* **84**(5), 054463 (2011).

V. V. Iyengar, B. K. Nayak, K. L. More, H. M. Meyer, M. D. Biegalski, J. V. Li, and M. C. Gupta, "Properties of Ultrafast Laser Textured Silicon for Photovoltaics," *Solar Energy Materials and Solar Cells* **95**(10), 2745 (2011).

N. Kemik, M. Gu, F. Yang, C. Y. Chang, Y. Song, M. Bibee, A. Mehta, M. D. Biegalski, H. M. Christen, N. D. Browning, and Y. Takamura, "Resonant X-Ray Reflectivity Study of Perovskite Oxide Superlattices," *Applied Physics Letters* **99**(20), 201908 (2011).

S. Lee, J. Jiang, J. D. Weiss, C. W. Bark, C. Tarantini, M. D. Biegalski, A. Polyanskii, Y. Zhang, C. T. Nelson, X. Q. Pan, E. E. Hellstrom, D. C. Larbalestier, and C. B. Eom, "Dependence of Epitaxial $Ba(Fe_{1-x}Co_x)_2As_2$ Thin Films Properties on $SrTiO_3$ Template Thickness," *IEEE Transactions on Applied Superconductivity* **21**(3), 2882 (2011).

E. Mutoro, E. J. Crumlin, M. D. Biegalski, H. M. Christen, and Y. Shao-Horn, "Enhanced Oxygen Reduction Activity on Surface-Decorated Perovskite Thin Films for Solid Oxide Fuel Cells," *Energy & Environmental Science* **4**(9), 3689 (2011).

E. Mutoro, E. J. Crumlin, H. Pöpke, B. Luerssen, M. Amati, M. K. Abyaneh, M. D. Biegalski, H. M. Christen, L. Gregoratti, J. Janek, and Y. Shao-Horn "Reversible Compositional Control of Oxide Surfaces by Electrochemical Potentials" Journal of Physical Chemistry Letters **3**(1), 40 (2011).

W. Siemons, M. D. Biegalski, J. H. Nam, and H. M. Christen, "Temperature-Driven Structural Phase Transition in Tetragonal-Like $BiFeO_3$," *Applied Physics Express* **4**(9), 095801 (2011).

F. Yang, N. Kemik, A. Scholl, A. Doran, A. T. Young, M. D. Biegalski, H. M. Christen, and Y. Takamura, "Correlated Domain Structure in Perovskite Oxide Superlattices Exhibiting Spin-flop Coupling," *Physical Review B* **83**(1), 014417 (2011).

M. D. Biegalski, K. Dorr, D. H. Kim, and H. M. Christen, "Applying Uniform Reversible Strain to Epitaxial Oxide Films," *Applied Physics Letters* **96**(15), 151905 (2010).

S. Coh, T. Heeg, J. H. Haeni, M. D. Biegalski, J. Lettieri, L. F. Edge, K. E. O'brien, M. Bernhagen, P. Reiche, R. Uecker, S. Trolier-Mckinstry, D. G. Schlom, and D. Vanderbilt, "Si-Compatible Candidates for High-Kappa Dielectrics with the Pbnm Perovskite Structure," *Physical Review B* **82**(6), 064101 (2010).

E. J. Crumlin, E. Mutoro, S. J. Ahn, G. J. La O, D. N. Leonard, A. Borisevich, M. D. Biegalski, H. M. Christen, and Y. Shao-Horn, "Oxygen Reduction Kinetics Enhancement on a Heterostructured Oxide Surface for Solid Oxide Fuel Cells," *Journal of Physical Chemistry Letters* **1**(21), 3149 (2010).

A. Herklotz, M. D. Biegalski, H. S. Kim, L. Schultz, K. Dorr, and H. M. Christen, "Wide-range Strain Tunability Provided by Epitaxial $LaAl_{1-x}Sc_xO_3$ Template Films," *New Journal of Physics* **12**, 113053 (2010).

H. W. Jang, A. Kumar, S. Denev, M. D. Biegalski, P. Maksymovych, C. W. Bark, C. T. Nelson, C. M. Folkman, S. H. Baek, N. Balke, C. M. Brooks, D. A. Tenne, D. G. Schlom, L. Q. Chen, X. Q. Pan, S. V. Kalinin, V. Gopalan, and C. B. Eom, "Ferroelectricity in Strain-Free $SrTiO_3$ Thin Films," *Physical Review Letters* **104**(19), 197601 (2010).

H. S. Kim, H. M. Christen, M. D. Biegalski, and D. J. Singh, "Proximity to a Ferroelectric Instability in $Ba_{1-x}Ca_xZrO_3$," *Journal of Applied Physics* **108**(5), 054105 (2010).

G. J. La O, S. J. Ahn, E. Crumlin, Y. Orikasa, M. D. Biegalski, H. M. Christen, and Y. Shao-Horn, "Catalytic Activity Enhancement for Oxygen Reduction on Epitaxial Perovskite Thin Films for Solid-Oxide Fuel Cells," *Angewandte Chemie-International Edition* **49**(31), 5344 (2010).

M. Varela, J. Gazquez, A. R. Lupini, J. T. Luck, M. A. Torija, M. Sharma, C. Leighton, M. D. Biegalski, H. M. Christen, M. Murfitt, N. Dellby, O. Krivanek, and S. J. Pennycook, "Applications of Aberration Corrected Scanning Transmission Electron Microscopy and Electron Energy Loss Spectroscopy to Thin Oxide Films and Interfaces," *International Journal of Materials Research* **101**(1), 21 (2010).

F. Yang, N. Kemik, M. D. Biegalski, H. M. Christen, E. Arenholz, and Y. Takamura, "Strain Engineering to Control the Magnetic and Magnetotransport Properties of $La_{0.67}Sr_{0.33}MnO_3$ Thin Films," *Applied Physics Letters* **97**(9), 092503 (2010).

A. Vasudevarao, S. Denev, M. D. Biegalski, Y. L. Li, L. Q. Chen, S. Trolier-Mckinstry, D. G. Schlom, and V. Gopalan, "Polarization Rotation Transitions in Anisotropically Strained $SrTiO_3$ Thin Films (vol 92, art no 192902, 2008)," *Applied Physics Letters* **94**(10), 109901 (2009).

E. Arenholz, G. Van Der Laan, F. Yang, N. Kemik, M. D. Biegalski, H. M. Christen, and Y. Takamura, "Magnetic Structure of $La_{0.7}Sr_{0.3}MnO_3/La_{0.7}Sr_{0.3}FeO_3$ Superlattices," *Applied Physics Letters* **94**(7), 072503 (2009).

M. D. Biegalski, E. Vlahos, G. Sheng, Y. L. Li, M. Bernhagen, P. Reiche, R. Uecker, S. K. Streiffer, L. Q. Chen, V. Gopalan, D. G. Schlom, and S. Trolier-Mckinstry, "Influence of Anisotropic Strain on the Dielectric and Ferroelectric Properties of $SrTiO_3$ Thin Films on $DyScO_3$ Substrates," *Physical Review B* **79**(22), 224117 (2009).

A. R. Lupini, A. Y. Borisevich, J. C. Idrobo, H. M. Christen, M. Biegalski, and S. J. Pennycook, "Characterizing the Two- and Three-Dimensional Resolution of an Improved Aberration-Corrected STEM," *Microscopy and Microanalysis* **15**(5), 441 (2009).

H. Z. Ma, J. Levy, M. D. Biegalski, S. Trolier-Mckinstry, and D. G. Schlom, "Room-Temperature Electro-optic Properties of Strained $SrTiO_3$ Films Grown on $DyScO_3$," *Journal of Applied Physics* **105**(1), 014102 (2009).

J. W. Park, S. H. Baek, C. W. Bark, M. D. Biegalski, and C. B. Eom, "Quasi-Single-Crystal (001) $SrTiO_3$ Templates on Si," *Applied Physics Letters* **95**(6), 061902 (2009).

Y. Takamura, F. Yang, N. Kemik, E. Arenholz, M. D. Biegalski, and H. M. Christen, "Competing Interactions in Ferromagnetic/Antiferromagnetic Perovskite Superlattices," *Physical Review B* **80**(18), 180417 (2009).

D. A. Tenne, P. Turner, J. D. Schmidt, M. Biegalski, Y. L. Li, L. Q. Chen, A. Soukiassian, S. Trolier-Mckinstry, D. G. Schlom, X. X. Xi, D. D. Fong, P. H. Fuoss, J. A. Eastman, G. B. Stephenson, C. Thompson, and S. K. Streiffer, "Ferroelectricity in Ultrathin $BaTiO_3$ Films: Probing the Size Effect by Ultraviolet Raman Spectroscopy," *Physical Review Letters* **103**(17), 177601 (2009).

A. Vasudevarao, S. Denev, M. D. Biegalski, Y. Li, L. Q. Chen, S. Trolier-Mckinstry, D. G. Schlom, and V. Gopalan, "Polarization Rotation Transitions in Anisotropically Strained $SrTiO_3$ Thin Films," *Applied Physics Letters* **92**(19), 192902 (2008).

M. D. Biegalski, D. D. Fong, J. A. Eastman, P. H. Fuoss, S. K. Streiffer, T. Heeg, J. Schubert, W. Tian, C. T. Nelson, X. Q. Pan, M. E. Hawley, M. Bernhagen, P. Reiche, R. Uecker, S. Trolier-Mckinstry, and D. G. Schlom, "Critical Thickness of High Structural Quality $SrTiO_3$ Films Grown on Orthorhombic (101) $DyScO_3$," *Journal of Applied Physics* **104**(11), 114109 (2008).

O. Bilani-Zeneli, A. D. Rata, A. Herklotz, O. Mieth, L. M. Eng, L. Schultz, M. D. Biegalski, H. M. Christen, and K. Dorr, "$SrTiO_3$ on Piezoelectric PMN-PT(001) for Application of Variable Strain," *Journal of Applied Physics* **104**(5), 054108 (2008).

H. M. Christen, D. H. Kim, H. N. Lee, M. D. Biegalski, and C. M. Rouleau, "INOR 418-Modifying the Properties of Perovskites via Strain and Interfacial Effects in Epitaxial Heterostructures," *Abstracts of Papers of the American Chemical Society* **235** (2008).

S. Denev, A. Kumar, M. D. Biegalski, H. W. Jang, C. M. Folkman, A. Vasudevarao, Y. Han, I. M. Reaney, S. Trolier-Mckinstry, C. B. Eom, D. G. Schlom, and V. Gopalan, "Magnetic Color Symmetry of Lattice Rotations in a Diamagnetic Material," *Physical Review Letters* **100**(25), 257601 (2008).

H. W. Jang, S. H. Baek, D. Ortiz, C. M. Folkman, R. R. Das, Y. H. Chu, P. Shafer, J. X. Zhang, S. Choudhury, V. Vaithyanathan, Y. B. Chen, D. A. Felker, M. D. Biegalski, M. S. Rzchowski, X. Q. Pan, D. G. Schlom, L. Q. Chen, R. Ramesh, and C. B. Eom, "Strain-Induced Polarization Rotation in Epitaxial (001) $BiFeO_3$ Thin Films," *Physical Review Letters* **101**(10), 107602 (2008).

D. H. Kim, H. N. Lee, M. D. Biegalski, and H. M. Christen, "Effect of Epitaxial Strain on Ferroelectric Polarization in Multiferroic $BiFeO_3$ Films," *Applied Physics Letters* **92**(1), 012911 (2008).

S. Trolier-Mckinstry, M. D. Biegalski, J. L. Wang, A. A. Belik, E. Takayama-Muromachi, and I. Levin, "Growth, Crystal Structure, and Properties of Epitaxial $BiScO_3$ Thin Films," *Journal of Applied Physics* **104**(4), 044102 (2008).

D. H. Kim, H. N. Lee, M. D. Biegalski, and H. M. Christen, "Large Ferroelectric Polarization in Antiferromagnetic $BiFe_{0.5}Cr_{0.5}O_3$ Epitaxial Films," *Applied Physics Letters* **91**(4), 042906 (2007).

M. B. Telli, S. S. N. Bharadwaja, M. D. Biegalski, J. G. Cheng, and S. Trolier-Mckinstry, "(001) Epitaxial $Ag(Ta_{0.5}Nb_{0.5})O_3$ Thin Films on $(001)SrRuO_3/(001)LaAlO_3$ Substrates by Chemical Solution Deposition," *Journal of Applied Physics* **101**(1), 014111 (2007).

M. A. Zurbuchen, R. S. Freitas, M. J. Wilson, P. Schiffer, M. Roeckerath, J. Schubert, M. D. Biegalski, G. H. Mehta, D. J. Comstock, J. H. Lee, Y. Jia, and D. G. Schlom, "Synthesis and Characterization of an n=6 Aurivillius Phase Incorporating Magnetically Active Manganese, $Bi_7(Mn,Ti)_6O_{21}$," *Applied Physics Letters* **91**(3), 033113 (2007).

M. Biegalski and S. Trolier-Mckinstry, "Modeling Optical Changes in Perovskite Capacitor Materials Due to dc-Field Degradation," *Journal of the American Ceramic Society* **88**(1), 71 (2005).

M. D. Biegalski, Y. Jia, D. G. Schlom, S. Trolier-Mckinstry, S. K. Streiffer, V. Sherman, R. Uecker, and P. Reiche, "Relaxor Ferroelectricity in Strained Epitaxial $SrTiO_3$ Thin Films on $DyScO_3$ Substrates," *Applied Physics Letters* **88**(19), 192907 (2006).

Y. L. Li, S. Choudhury, J. H. Haeni, M. D. Biegalski, A. Vasudevarao, A. Sharan, H. Z. Ma, J. Levy, V. Gopalan, S. Trolier-Mckinstry, D. G. Schlom, Q. X. Jia, and L. Q. Chen, "Phase Transitions and Domain Structures in Strained Pseudocubic (100) $SrTiO_3$ Thin Films," *Physical Review B* **73**(18), 184112 (2006).

M. B. Telli, S. S. N. Bharadwaja, M. D. Biegalski, and S. Trolier-Mckinstry, "(00L) Epitaxial $AgTaO_3$ and $AgNbO_3$ Thin Films on $(001)SrRuO_3/(001)LaAlO_3$ Substrates by Chemical Solution Deposition," *Applied Physics Letters* **89**(25), 252907 (2006).

M. D. Biegalski, J. H. Haeni, S. Trolier-Mckinstry, D. G. Schlom, C. D. Brandle, and A. J. Ven Graitis, "Thermal Expansion of the New Perovskite Substrates $DyScO_3$ and $GdScO_3$," *Journal of Materials Research* **20**(4), 952 (2005).

K. J. Choi, M. Biegalski, Y. L. Li, A. Sharan, J. Schubert, R. Uecker, P. Reiche, Y. B. Chen, X. Q. Pan, V. Gopalan, L. Q. Chen, D. G. Schlom, and C. B. Eom, "Enhancement of Ferroelectricity in Strained $BaTiO_3$Thin Films," *Science* **306**(5698), 1005 (2004).

M. Biegalski, R. Thayer, J. Nino, and S. Trolier-Mckinstry, "Dielectric Properties of Capacitor Materials in the Optical Frequency Range," in *Applications of Ferroelectrics, Proceedings of the13th IEEE Symposium on Applications of Ferroelectrics, pgs. 7-10, Eds., G. White and T. Tsurumi*, Nara, Japan, (2002).

S. J. Lee, M. D. Biegalski, and W. M. Kriven, "Powder Synthesis of Barium Titanate and Barium Orthotitanate via an Ethylene Glycol Complex Polymerization Route," *Journal of Materials Research* **14**(7), 3001 (1999).