

## Raymond E. Schaak

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### Education and Experience

- 2001 – 2003 Postdoctoral Research Associate, Department of Chemistry and Princeton Materials Institute, Princeton University  
Advisor: Prof. Robert J. Cava
- 1998 – 2001 Ph.D., chemistry, Pennsylvania State University (*NSF Graduate Fellow*)  
Advisor: Prof. Thomas E. Mallouk
- 1994 – 1998 B.S., chemistry (honors, ACS certified), Lebanon Valley College  
Research advisors: Profs. Donald B. Dahlberg and Richard D. Cornelius

### Appointments

- 2004 – present Member, Materials Science and Engineering Faculty, Texas A&M University  
2003 – present Assistant Professor, Department of Chemistry, Texas A&M University

### Honors and Awards

- DuPont Young Professor Grant, 2006 – 2009  
Beckman Young Investigator Award, 2006 – 2009  
NSF CAREER Award, 2006 – 2011  
American Chemical Society Petroleum Research Fund Type G New Faculty Award, 2004 – 2006  
National School on X-ray and Neutron Scattering, Argonne National Laboratories, 2001  
Materials Research Society Graduate Student Award (Silver), 2000  
Dan Waugh Memorial Teaching Award (Honorable Mention), Pennsylvania State University, 2000  
Graduate Student Research Award, Pennsylvania State University, 2000, 2001  
National Science Foundation Graduate Research Fellowship, 1999-2001  
Department of Defense Graduate Fellowship Competition (Honorable Mention), 1999  
University Graduate Fellowship, Pennsylvania State University, 1998-1999  
Roberts Fellowship, Pennsylvania State University, 1998-2000  
Andrew Bender Memorial Chemistry Award, Lebanon Valley College, 1998  
Departmental Honors (Chemistry), Lebanon Valley College, 1998  
Phi Alpha Epsilon Honors Society, Lebanon Valley College, 1998  
Freshman/Sophomore/Physical Chemistry Awards in Chemistry, Lebanon Valley College, 1995, 1996, 1997

### Professional Activities and Affiliations

- Member, American Chemical Society (*Inorganic* division, *Solid-State & Nanoscience* subdivisions)  
Peer Reviewer, *Journal of the American Chemical Society*, *Chemistry of Materials*, *Inorganic Chemistry*, *Langmuir*, *Journal of Physical Chemistry B*, *Advanced Functional Materials*, *Journal of Solid State Chemistry*, *Chemical Communications*, *Journal of Materials Chemistry*, *Journal of Alloys and Compounds*, *Chemical Physics Letters*, *Materials Research Bulletin*, *Journal of Nanoparticle Research*, *Nanotechnology*  
Proposal Reviewer, ACS – PRF and NSF (*CHE/IBO*, *CHE/ASC*, *DMR/SSC*, *DMR/MET*)  
Invited participant, NSF Workshop on *Materials Chemistry and Nanoscience* (2004)  
Invited participant, NSF Workshop on *Inorganic Chemistry* (2005)  
Invited participant, NSF panel on *The Status of Solid State Chemistry and its Impact in the Physical Sciences – Synthesis and New Materials* (2006)  
Symposium Organizer (*Inorganic Synthetic Strategies in Nanoscience*), 2006 Spring ACS meeting (Atlanta)  
Symposium Organizer (Presidential Event; Poster Session – *SWNTs from Synthesis to Applications, From the Lab to the Fab: In Memory of Dr. Richard Smalley*), 2006 Fall ACS meeting (San Francisco)  
Symposium Organizer (*Solid State Chemistry*), 2006 Midwest ACS Regional Meeting (Quincy, IL)  
Symposium Organizer (*Nanoscale Inorganic Catalysis*), 2007 Spring ACS meeting (Chicago)

## Research Interests

Solid-state chemistry; new low-temperature synthetic routes to solid-state materials; solid-state reactivity, reactions, and reaction pathways; intermetallic and alloy nanomaterials; nanoparticle self-assembly; metastable materials; multifunctional composites; nanostructured catalysts; low-temperature routes to nanostructured non-oxide ceramics; non-lithographic patterning; synthesis and structures of complex materials.

## Invited Presentations (since arriving at Texas A&M in 2003)

- 2007** Princeton University (03/01/07) – Selected, invited, and hosted by graduate students  
Air Products (Allentown, PA; March 2007)
- 2006** Iowa State University (11/17/06)  
41<sup>st</sup> Midwest Regional Meeting of the American Chemical Society (10/25/06 – 10/27/06)  
61<sup>st</sup> Southwest Regional Meeting of the American Chemical Society (10/19/06 – 10/22/06)  
Pennsylvania State University (09/25/06)  
Duquesne University (09/22/06)  
Carnegie Mellon University (09/21/06)  
Trans-Atlantic Frontiers in Chemistry (08/10/06 – 08/13/06)  
Solid State Chemistry Gordon Research Conference (07/23/06 – 07/28/06)  
Inorganic Chemistry Gordon Research Conference (07/16/06 – 07/21/06)  
38<sup>th</sup> Middle Atlantic Regional Meeting of the American Chemical Society (06/04/06 – 06/07/06)  
Kentucky State University (04/28/06)  
American Chemical Society – Lexington (KY) Section (04/27/06)  
231<sup>st</sup> National Meeting of the American Chemical Society – Symposium on “Nanotechnology and the Environment” (03/26/06)  
University of North Carolina – Chapel Hill (02/28/06)  
University of North Carolina – Charlotte (02/27/06)  
North Carolina State University (02/24/06)
- 2005** PacifiChem 2005 [*Keynote speaker*, symposium on “Solid State Chemistry: Novel Syntheses and New Materials”] (12/19/05)  
Lebanon Valley College (11/21/05)  
Bloomsburg University (11/18/05)  
University of Texas – Dallas (09/21/05)  
DuPont – Central Research and Development, Experimental Station, Wilmington DE [*Discovery Chemistry Seminar Series*] (09/14/05)  
230<sup>th</sup> National Meeting of the American Chemical Society – ExxonMobil Solid State Faculty Fellowship Award Symposium honoring Ram Seshadri (08/30/05)  
NSF Inorganic Chemistry Workshop (06/07/05 – 06/10/05)  
University of California – Davis (05/12/05)
- 2004** Texas A&M University – Commerce (11/18/04)  
NSF Materials Workshop (10/28/04 – 10/31/04)  
Texas Lutheran University (09/24/04)

## Current and Awarded Funding

- Texas Higher Education Coordinating Board (Advanced Research Program) – “Chemical Synthesis of Nanostructured Shape Memory Alloys” [\$100,000: 2006 – 2008]
- NSF Graduate Research Fellowship – Awarded to Amanda Henkes [\$121,500: 2006 – 2009]
- DuPont Young Professor Grant – Nominated by Nyriisa Rogado [\$75,000: 2006 – 2009]
- Beckman Young Investigator Award – “A New Polymer-Assisted Galvanic Approach to Hollow Multi-Metal Nanospheres for Biomedical, Plasmonic, and Fuel Cell Applications” [\$264,000: 2006 – 2009]
- ACS-PRF (Type AC) – “New Structures of Old Elements: Low-Temperature Solution Routes to Metastable Polymorphs” [\$80,000: 2006 – 2008]
- NSF-CAREER (DMR/SSC) – “Low-Temperature Solution Synthesis of Intermetallic Nanomaterials” [\$551,588: 2006 – 2011]
- Robert A. Welch Foundation – “Synthesis of Exotic Solid-State Materials with Nanoscale Geometric Confinement” [\$150,000: 2004 – 2007]
- ACS-PRF (Type G and Summer Research Fellowship Supplement) – “Synthesis and Thermodynamic Studies of Atomically Ordered Nanocrystals” [\$43,000: 2004 – 2006]

## Teaching

Undergraduate: General Chemistry for Engineering Students, Advanced Inorganic Laboratory

Graduate: Advanced Materials Chemistry, Graduate Seminar

## Service (Texas A&M)

Executive Committee, Materials Science & Engineering Ph.D. Program

College of Science representative, Electron Microscopy Advisory Committee for the Microscopy and Imaging Center

Faculty advisor, Texas A&M Chapter of Phi Lambda Upsilon

Member, Service Course Curriculum Committee

Coordinator, Inorganic Student Research Seminars

Internal Selection Committees (various), Office of Sponsored Projects limited submission proposal panels

Member, Center for Microchemical Systems.

## Current Research Group

Robert Cable	3 <sup>rd</sup> year graduate student (2003 – present)
Brian Leonard	3 <sup>rd</sup> year graduate student (2003 – present)
Yolanda Vasquez	3 <sup>rd</sup> year graduate student (2003 – present)
J. Chris Bauer	2 <sup>nd</sup> year graduate student (2004 – present)
Amanda Henkes	2 <sup>nd</sup> year graduate student (2004 – present) – NSF Grad Fellowship Awardee
Nam Hawn Chou	2 <sup>nd</sup> year graduate student (2004 – present)
Nathaniel Henderson	1 <sup>st</sup> year graduate student (2005 – present) – NSF Grad Fellowship Hon. Ment.
Farah Dawood	1 <sup>st</sup> year graduate student (2005 – present)
Trevor Ewers	Undergraduate (2003 – present; chemistry major)
Jason Knight	Undergraduate (2006 – present; biomedical engineering major)
Jeffrey Karnes	Undergraduate (2006 – present; chemistry major)
Aaron Ofczarzak	Undergraduate (2006 – present; chemical engineering major)
Nicholas Fox	Undergraduate (summer 2006; NSF-REU student from Bloomsburg Univ.)
Matthew Sanders	Undergraduate (2006 – present; mechanical engineering major)

## Former Group Members

Amandeep Sra	Postdoc, 2003 – 2005 (currently a research scientist at UT-Dallas)
Ronaldo Cavazos	Undergraduate, 2003 – 2004 (currently a high school teacher in Misson, TX)
Brent Norris	Undergraduate, 2003 – 2005 (currently a grad student at UT-Austin)
Christopher Dille	Undergraduate, 2003
Edward Funck	Undergraduate (NSF-REU), 2004 (currently a grad student at Texas A&M)
Zachary Schaefer	Undergraduate (NSF Summer Program in Solid State Chemistry), 2005 (currently a grad student at Texas A&M)
Oliver Willingham	Undergraduate, 2005 (civil engineering major)
Eric Hendrickson	Undergraduate, 2005 (currently working at General Electric, Houston TX)
Raiman Johnson	Undergraduate, 2005
Dawood Afzal	Visiting Professor (Truman State Univ., supported by PRF), Summer 2005

## Student Presentations and Posters

- Brian Leonard (grad student) – 229<sup>th</sup> National ACS Meeting, San Diego CA (March 2005 – poster)
- Trevor Ewers (undergraduate) – 229<sup>th</sup> National ACS Meeting, San Diego CA (March 2005 – poster)
- Brian Leonard (grad student) – TAMU Student Research Week (April 1, 2005 – poster)
- Robert Cable (grad student) – TAMU Student Research Week (April 1, 2005 – poster)
- Amandeep Sra (postdoc) – Clusters, Nanocrystals, and Nanostructures Gordon Conference (July 2005)
- Robert Cable (grad student) – 230<sup>th</sup> National ACS Meeting, Washington DC (Sept 2005 – poster)
- Robert Cable (grad student) – 230<sup>th</sup> National ACS Meeting, Washington DC (Sept 2005 – oral)
- Yolanda Vasquez (grad student) – IUCCP poster session (October 2005 – poster)
- Robert Cable (grad student) – IUCCP poster session (October 2005 – poster)
- Amanda Henkes (grad student) – 231<sup>st</sup> National ACS Meeting, Atlanta GA (March 2006 – poster)

- Yolanda Vasquez (grad student) – 231<sup>st</sup> National ACS Meeting, Atlanta GA (March 2006 – poster)
- Robert Cable (grad student) – TAMU Student Research Week (March 28, 2006 – oral)
- Brian Leonard (grad student) – TAMU Student Research Week (March 28, 2006 – oral)
- Chris Bauer (grad student) – TAMU Student Research Week (March 30, 2006 – poster)
- Nam Hawn Chou (grad student) – TAMU Student Research Week (March 30, 2006 – poster)
- Brian Leonard (grad student) – Solid State Chemistry Gordon Conference (July 2006 – poster)
- Robert Cable (grad student) – Solid State Chemistry Gordon Conference (July 2006 – poster)

### Student Awards (external awards are highlighted)

- Robert Cable (grad) – 3<sup>rd</sup> place at TAMU Student Research Week – Poster, April, 2005
- Robert Cable (grad) – 4<sup>th</sup> place at TAMU Student Research Week – Oral, March 2006
- Robert Cable (grad) – Martin Corera Travel Award (for Solid State GRC) – April 2006
- Farah Dawood (grad) – Outstanding Contribution, Living Curriculum Initiative (TAMU 1<sup>st</sup> Year Program)
- Trevor Ewers (undergrad) – Distinguished Student Award (2005)
- Trevor Ewers (undergrad) – IUCCP-A.E. Martell Undergraduate Chemistry Scholarship (2004-2005)
- Trevor Ewers (undergrad) – ACS-SAC Academic Chair (2004-2005)
- Trevor Ewers (undergrad) – Dow Undergraduate Chemistry Scholarship (2005-2006)
- Trevor Ewers (undergrad) – ACS Travel grant (2005)
- Trevor Ewers (undergrad) – ACS-SAC President (2005-2006)
- Nathaniel Henderson (grad) – **NSF Graduate Research Fellowship – Honorable Mention** (2006)
- Amanda Henkes (grad) – **Travel Award (ACS Division of Inorganic Chemistry)** – March 2006
- Amanda Henkes (grad) – **NSF Graduate Research Fellowship** (2006 – 2009)
- Brian Leonard (grad) – Selected to participate in training course at Brookhaven National Laboratory, National Synchrotron Light Source: **“High Resolution Powder Diffraction Data Analysis”** – Jan 2005
- Brian Leonard (grad) – **Travel Award (ACS Division of Inorganic Chemistry)** – March 2005
- Brian Leonard (grad) – 1<sup>st</sup> place at TAMU Student Research Week – Poster, April 2005
- Brian Leonard (grad) – 2<sup>nd</sup> place at TAMU Student Research Week – Oral, March 2006
- Brian Leonard (grad) – Martin Corera Travel Award (for Solid State GRC) – April 2006
- Yolanda Vasquez (grad) – Outstanding poster, IUCCP symposium – October 2005
- Yolanda Vasquez (grad) – **Eli Lilly & Co. Women Chemists Committee Travel Award** – Nov 2005
- Yolanda Vasquez (grad) – Martell Travel Award – March 2006

### Publications

#### **Publications from Texas A&M (since June 2003)**

34. N.H. Chou\* and R.E. Schaak, “Shape-Controlled Synthesis of Intermetallic FeSn<sub>2</sub> and PdSn Nanocrystals,” submitted.
33. A.E. Henkes,\* Y. Vasquez,\* and R.E. Schaak, “Synthesis of PdP<sub>2</sub> and Pd<sub>5</sub>P<sub>2</sub> Nanostructures: Solution-Mediated Conversion of Metals into Metal Polyphosphides,” submitted.
32. R.E. Cable\* and R.E. Schaak, “Reacting the Unreactive: A Toolbox of Low-Temperature Solution-Mediated Reactions for the Facile Interconversion of Nanocrystalline Intermetallic Compounds,” submitted.
31. B.M. Leonard\* and R.E. Schaak, “Multi-Step Solution-Mediated Formation of Nanocrystalline AuCuSn<sub>2</sub>: Mechanistic Insights for the Guided Design of Intermetallic Solid State Materials and Complex Multi-Metal Nanocrystals,” submitted to *J. Am. Chem. Soc.* [**In revision – acceptance pending revision**]
30. A.K. Sra, T.D. Ewers,<sup>#</sup> Q. Xu, H. Zandbergen, and R.E. Schaak, “One-Pot Synthesis of Bi-Disperse FePt Nanoparticles and Spontaneous Assembly into Two-Dimensional AB<sub>2</sub>, AB<sub>5</sub>, and AB<sub>13</sub> Superlattices,” *Chem. Commun.* **2006**, 750-752.
29. C.-C. Chen, Y. Bisrat, Z. Luo, R.E. Schaak, C.-G. Chao, and D.C. Lagoudas, “Fabrication of Single Crystal Tin Nanowires by Hydraulic Pressure Injection,” *Nanotechnology* **2006**, 17, 367-374.

28. A.E. Henkes,\* J.C. Bauer,\* R.D. Johnson,# A.K. Sra, R.E. Cable,\* and R.E. Schaak, "Low-Temperature Nanoparticle-Directed Solid State Synthesis of Ternary and Quaternary Transition Metal Oxides," *Chem. Mater.* **2006**, *18*, 567-571.
27. R.E. Cable\* and R.E. Schaak, "Low-Temperature Solution Synthesis of Nanocrystalline Binary Intermetallic Compounds using the Polyol Process," *Chem. Mater.* **2005**, *17*, 6835-6841.
26. Y. Vasquez,\* A.K. Sra, and R.E. Schaak, "One-Pot Synthesis of Hollow Superparamagnetic CoPt Nanospheres," *J. Am. Chem. Soc.* **2005**, *127*, 12504-12505.
25. B.M. Leonard,\* N.S.P. Bhuvanesh, and R.E. Schaak, "Low-Temperature Polyol Synthesis of AuCuSn<sub>2</sub> and AuNiSn<sub>2</sub>: Using Solution Chemistry to Access New Ternary Intermetallic Compounds as Nanocrystals," *J. Am. Chem. Soc.* **2005**, *127*, 7326-7327.

**[Featured in *Chemical & Engineering News* (May 16, 2005) and *Gold Bulletin* (Vol. 38, #3, 2005)]**

24. R.E. Schaak, A.K. Sra, B.M. Leonard,\* R.E. Cable,\* J.C. Bauer,\* Y.-F. Han, J. Means, W. Teizer, Y. Vasquez,\* E.S. Funck,# "Metallurgy in a Beaker: Nanoparticle Toolkit for the Rapid Low-Temperature Solution Synthesis of Functional Multimetallic Solid State Materials," *J. Am. Chem. Soc.* **2005**, *127*, 3506-3515.

**[Featured in *Chemical & Engineering News* (May 16, 2005) and *NanoTech Alert – Technical Insights* (Frost & Sullivan, Feb 25, 2005)]**

23. T.D. Ewers,# A.K. Sra, B.C. Norris,# R.E. Cable,\* C.-H. Cheng, D.F. Shantz, and R.E. Schaak, "Spontaneous Hierarchical Assembly of Rhodium Nanoparticles into Spherical Aggregates and Superlattices," *Chem. Mater.* **2005**, *17*, 514-520.
22. A.K. Sra, T.D. Ewers,# and R.E. Schaak, "Direct Solution Synthesis of Intermetallic AuCu and AuCu<sub>3</sub> Nanocrystals and Nanowire Networks," *Chem. Mater.* **2005**, *17*, 758-766.
21. A.K. Sra and R.E. Schaak, "Synthesis of Atomically Ordered AuCu and AuCu<sub>3</sub> Nanocrystals from Bimetallic Nanoparticle Precursors," *J. Am. Chem. Soc.* **2004**, *126*, 6667-6672.
20. N.M. Abrams and R.E. Schaak, "Self-Assembled Colloidal Crystals: Visualizing Atomic Crystal Chemistry using Microscopic Analogues of Inorganic Solids," *J. Chem. Educ.*, **2005**, *82*, 450-452.
19. R.E. Schaak, R.E. Cable,\* B.M. Leonard,\* and B.C. Norris,# "Colloidal Crystal Microarrays and Two-Dimensional Superstructures: A Versatile Approach for Patterned Surface Assembly," *Langmuir* **2004**, *20*, 7293-7297.
18. R.J. Cavazos# and R.E. Schaak, "Synthesis of the New Layered Oxides NaRbLnMO<sub>5</sub> (Ln = La, Nd, Sm, Eu, Gd; M = Nb, Ta)", *Mater. Res. Bull.* **2004**, *39*, 1209-1214.

**Publications – Prior to Texas A&M** (graduate and postdoctoral work)

17. R.E. Schaak and R.J. Cava, "Boron Substitution in Ternary Metal Phosphide Superconductors," *Mater. Res. Bull.* **2004**, *39*, 1231-1235.
16. J.W. Lynn, Q. Huang, C.M. Brown, V.L. Miller, M.L. Foo, R.E. Schaak, C.Y. Jones, E.A. Mackey, and R.J. Cava, "Structure and Dynamics of Superconducting Na<sub>x</sub>CoO<sub>2</sub> Hydrate and Its Unhydrated Analog," *Phys. Rev. B.*, **2003**, *68*, 214516.
15. B.G. Ueland, P. Schiffer, R.E. Schaak, M.L. Foo, V.L. Miller, and R.J. Cava, "Specific Heat Study of the Na<sub>0.3</sub>CoO<sub>2</sub>·1.3H<sub>2</sub>O Superconductor: Influence of the Complex Chemistry," *Physica C*, **2004**, *402*, 27-30.
14. R.E. Schaak, T. Klimczuk, M.L. Foo, and R.J. Cava, "Superconductivity Phase Diagram of Na<sub>x</sub>CoO<sub>2</sub>·1.3H<sub>2</sub>O," *Nature*, **2003**, *424*, 527-529.
13. M.L. Foo, R.E. Schaak, V.L. Miller, T. Klimczuk, N.S. Rogado, Y. Wang, G.C. Lau, C. Craley, H.W. Zandbergen, N.P. Ong, and R.J. Cava, "Chemical Instability of the Cobalt Oxyhydrate Superconductor Under Ambient Conditions," *Solid State Commun.*, **2003**, *127*, 33-37.
12. R.E. Schaak, M. Avdeev, W.-L. Lee, G. Lawes, H.W. Zandbergen, J.D. Jorgensen, N.P. Ong, A.P. Ramirez, and R.J. Cava, "Formation of Transition Metal Boride and Carbide Perovskites Related to Superconducting MgCNi<sub>3</sub>," *J. Solid State Chem.*, **2004**, *177*, 1244-1251.

11. R.E. Schaak and T.E. Mallouk, "Exfoliation of Layered Rutile and Perovskite Tungstates," *J. Chem. Soc., Chem. Commun.*, **2002**, 706-707.
10. R.E. Schaak, D. Afzal, J.A. Schottenfeld, and T.E. Mallouk, " $\text{Na}_2\text{Ln}_2\text{Ti}_{3-x}\text{Mn}_x\text{O}_{10}$  ( $\text{Ln} = \text{Sm}, \text{Eu}, \text{Gd}, \text{Dy}$ ;  $0 \leq x \leq 1$ ): A New Series of Ion-Exchangeable Layered Perovskites Containing B-Site Manganese," *Chem. Mater.*, **2002**, *14*, 442-448.
9. R.E. Schaak and T.E. Mallouk, "Perovskites by Design: A Toolbox of Solid-State Reactions," *Chem. Mater.*, **2002**, *14*, 1455-1471. [Review article; featured on the cover, April 2002]
8. R.E. Schaak and T.E. Mallouk, " $\text{KLnTiO}_4$  ( $\text{Ln} = \text{La}, \text{Nd}, \text{Sm}, \text{Eu}, \text{Gd}, \text{Dy}$ ): A New Series of Ruddlesden-Popper Phases Synthesized by Ion Exchange of  $\text{HLnTiO}_4$ ," *J. Solid State Chem.*, **2001**, *161*, 225-232.
7. R.E. Schaak, E.N. Guidry, and T.E. Mallouk, "Converting a Layer Perovskite into a Non-Defective Higher-Order Homologue: Topochemical Synthesis of  $\text{Eu}_2\text{CaTi}_2\text{O}_7$ ," *J. Chem. Soc., Chem. Commun.*, **2001**, 853-854.
6. R.E. Schaak and T.E. Mallouk, "Prying Apart Ruddlesden-Popper Phases: Exfoliation into Sheets and Nanotubes for Assembly of Perovskite Thin Films," *Chem. Mater.*, **2000**, *12*, 3427-3434.
5. R.E. Schaak and T.E. Mallouk, "Self-Assembly of Tiled Perovskite Monolayer and Multilayer Thin Films," *Chem. Mater.*, **2000**, *12*, 2513-2516.
4. R.E. Schaak and T.E. Mallouk, "Synthesis, Proton Exchange, and Topochemical Dehydration of New Ruddlesden-Popper Tantalates and Titanotantalates," *J. Solid State Chem.*, **2000**, *155*, 46-54.
3. G.L. Egan, J.-S. Yu, C.H. Kim, S.J. Lee, R.E. Schaak, and T.E. Mallouk, "Nanoscale Metal Replicas of Colloidal Crystals," *Adv. Mater.*, **2000**, *12*, 1040-1042.
2. R.E. Schaak and T.E. Mallouk, "Topochemical Synthesis of Three-Dimensional Perovskites from Lamellar Precursors," *J. Am. Chem. Soc.*, **2000**, *122*, 2798-2803.
1. R.E. Schaak, D.B. Dahlberg, and K.B. Miller, "The Electronic Nose: Studies on the Fundamental Response and Discriminative Power of Metal-Oxide Sensors," *Electronic Noses and Sensor Array Based Systems, Design and Applications*, Proceedings of the 5<sup>th</sup> International Symposium of Olfaction and Electronic Nose, Ed. W. Jeffrey Hurst, **1999**, Technomic Pub. Co., Inc.