

Kai Xiao

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Education

East China Institute of Technology, China	Chemistry	B.A., 1998
Institute of Metal Research, Chinese Acad. of Sci., China	Material Science & Engr.	M. S., 2001
Institute of Chemistry, Chinese Acad. of Sci., China	Physical Chemistry	Ph. D., 2004

Professional Experience

2008–p Research Staff Member, Center for Nanophase Materials Sciences, Oak Ridge National Laboratory (ORNL)
2011–p Joint Assistant Professor, Department of Electrical Engineering and Computer Sciences, University of Tennessee, Knoxville (UTK)
2004–2008 Postdoctoral Research Associate, Center for Nanophase Materials Sciences, ORNL

Professional and Synergistic Activities

2011 Session Chair, 10th International Symposium on Functional π -Electron Systems, Beijing, China, October 13, 2011
2008–p Editorial Board, *Open Materials Science Journal*
2006–p Member, Materials Research Society; American Chemical Society
2005–p Reviewer, *J. Am. Chem. Soc.*; *J. Phys. Chem. B*; *Chem. Mater.*; *Angew. Chem. Int. Ed.*; *Adv. Mater.*; *Adv. Func. Mater.*; *Small*; *Appl. Phys. Lett.*; *Nanoscale*; *J. Mater. Chem.*; *Polymer Reviews*

Honors and Awards

2007 The National Top 100 Excellent Ph. D. Thesis Award in China, Ministry of Education
2006 The Top 50 Excellent Ph. D. Thesis Award of the Chinese Academy of Sciences
2004 Outstanding Thesis Award of the 24th Annual Meeting, Chinese Chemical Society

Patents

“Fabrication of Thin-Film Transistors Based on Aligned Carbon Nanotubes,” Y.Q. Liu, K. Xiao, P.A. Hu, G. Yu, X. B. Wang, D. B. Zhu, CN ZL 02145889.8, 2002.
“Fabrication and Application of CN_x/C Nanotube Junctions,” Y. Q. Liu, P. A. Hu, K. Xiao, X. B. Wang, L. Fu, D. B. Zhu, CN ZL 02160815.6, 2002.
“A Synthesis Method of Three-Dimensional Carbon Nanotube Alignments,” Y. Q. Liu, X. B. Wang, P. A. Hu, G. Yu, K. Xiao, and D. B. Zhu, CN ZL 02102542.8, 2002.
“A New Method for the Fabrication of Nanotube-FET Devices Based on N-doped Carbon Nanotubes,” Y. Q. Liu, K. Xiao, P. A. Hu, G. Yu, L. Fu, D. B. Zhu, CN ZL 03108244, 2003.
“Process for Preparing a CN_x/C Nanotube Diodes and Its Rectifying Properties,” Y. Q. Liu, K. Xiao, P. A. Hu, G. Yu, L. Fu, D.B. Zhu, CN ZL 03104280.5, 2003.
“Fabrication Way and Application of 5,5'-bis-biphenyl-dithieno[3,2-b:2',3'-d]thiophene Compounds,” Y. Q. Liu, Y. Sun, Y. Ma, K. Xiao, G. Yu, D. Zhu, CN ZL 200410046350.8, 2004.
“Fabrication Way of Field-Effect Transistors Controlled by Light Intensity,” Y. Q. Liu, K. Xiao, Y. Fu, G. Yu, Y. Luo, J. Zhai, L. Jiang, W. Hu and D. Zhu, CN ZL 200410101837.1, 2004.

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

- “Isotope Effect of Deuterated P3HT on Charge Transport and Solar Harvesting,” International Conference on Science and Technology of Synthetic Metals, Atlanta, Georgia, July 8-13, 2012.*
- “Self-Assembly of Conjugated Block Copolymers for Organic Field-Effect Transistors and Photovoltaics,” The 10th Int. Symposium on Functional π -Electron Systems, Beijing, China, Oct. 13, 2011.
- “Self-Assembled Single Crystal Organic Nanowires for High-performance Memory Devices,” Workshop on Self-Assembled Organic Nanomaterials: Structure and Function at The Molecular Foundry, Lawrence Berkeley National Laboratory, San Francisco, CA, Oct. 5-6, 2011.*
- “Block Copolymer Controlled Morphology of P3HT/PCBM Photovoltaics,” 4th Workshop on Sustainable Energy Future: Nanomaterials Enabled Photovoltaics, ORNL, Oak Ridge, TN, Sept. 22-23, 2011.*
- “Tailored Assemblies of PS-*b*-P3HT Diblock Copolymers: Adaptable Building Blocks for High-Performance Organic Transistors and Solar Cells”, 2011 EBMC-NSRC Contractors' Meeting, Annapolis, MD, May 31, 2011.*
- “One-Dimensional Electron-Transport in Self-Assembled Organic Nanowires,” 9th International Symposium on Functional π -Electron Systems, Atlanta, GA, Oct. 6, 2010.
- “Synthesis of Organic Semiconductor Nanowires for Solar Cells”, 3th Workshop on Sustainable Energy Future: Nanomaterials Enabled Photovoltaics, ORNL, Oak Ridge, TN, Sept. 22, 2010.*

Publications *Full publication list follows CV*

Research Synopsis:

1. ***Carbon-based nanomaterials, including carbon nanotubes, graphene, organic nanowires.***
Synthesis of organic nanomaterials using vapor-solid chemical reaction and solution processing; Optical, structural and electrical characterization of carbon-based nanomaterials; Charge transport study of carbon-based nanomaterials;
2. ***Organic semiconductor materials and thin-film electronics, including organic field-effect transistors (OFETs) and organic photovoltaics (OPVs), spin valves, organic memory, sensors.***
Optical and optoelectronic characterization of organic semiconductor materials (small molecules and polymers); Processing organic semiconductor materials using various methods, including spin-coating, thermal deposition, spray printing, to form gradient or doped single/multilayer thin films for organic electronic devices (OFETs, OPVs, memories, sensors). Structure-property relationship of organic semiconductor materials;
3. ***Inorganic/organic nanoscale electronics.***
Fabrication 1D and 2D nanoscale electronic devices (FETs, photodetectors, memories) of inorganic/organic nanostructures using various processing technologies and testing of nanoscale devices in controlled environment (inert glove box or temperature-controlled probe station).

Collaborations: J. Browning (ORNL); D. B. Geohegan (ORNL); G. Gu (UTK); D. W. Li (Univ. of AL); J. Tao (Brookhaven National Laboratory); N. S. Goroff (Stony Brook Univ.); K. Hong (ORNL); B. Hu (UTK); W. Hu (CAS); R. J. Narayan (NC State Univ.); Z. Pan (Univ. of GA); E. A. Payzant (ORNL); S. J. Pennycook (ORNL); S. M. Weiss (Vanderbilt Univ.); L. Zhu (Case Western Reserve Univ.)

Graduate and Postdoctoral Advisors and Advisees:

Graduate Advisor: Prof. Daoben Zhu (Institute of Chemistry, Chinese Academy of Sciences)
Postdoctoral Advisor: Dr. David B. Geohegan (Oak Ridge National Laboratory)

Graduate and Postdoctoral Advisees:

Graduate: Sanjib Das (Univ. of TN, Knoxville); Wan Deng (Univ. of TN, Knoxville); Peixing Liu (Univ. of TN, Knoxville)
Postdoctoral: Ming Shao (Oak Ridge National Laboratory)

PUBLICATIONS

Kai Xiao

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Recent Book Chapters

- D. B. Geohegan, A. A. Poretzky, C. M. Rouleau, J. J. Jackson, G. Eres, Z. Liu, D. Styers-Barnett, H. Hu, B. Zhao, K. Xiao, I. Ivanov, and K. More, "Laser Interactions in Nanomaterials Synthesis," Chapter 1 in *Laser-Surface Interactions for New Materials Production: Tailoring Structure and Properties*, Springer Series in Materials Science, Vol. 130, Miotello, Antonio; Ossi, Paolo M., Eds., ISBN: 978-3-642-03306-3 (2010).
- X. B. Sun, K. Xiao, D. Q. Zhang, Y. Q. Liu, D. B. Zhu, "Organic Semiconductor Materials," Chapter in *Materials Science and Engineering*, Eds. C. X. Shi, H. D. Li, and L. Zhou, Chemical Engineering Publishers, Beijing, China (2004).

Refereed Journal Papers (Journals with Impact Factor > 4*):

- K. Xiao, M. Yoon, A. J. Rondinone, E. A. Payzant, and David B. Geohegan, "Understanding the Metal-Directed Growth of Single-Crystal M-TCNQF₄ Organic Nanowires with Time-Resolved, in Situ X-ray Diffraction and First-Principles Theoretical Studies," *Journal of the American Chemical Society* DOI: 10.1021/ja301456p, (2012). *
- P. Hu, Z. Wen, L. Wang, P. Tan, K. Xiao, "Synthesis of Few-Layer GaSe Nanosheets for High Performance Photodetectors," *ACS Nano* **6**, 5988 (2012). *
- J. Chen, X. Yu, K. Hong, J. M. Messman, D. L. Pickel, K. Xiao, M. D. Dadmun, J. W. Mays, A. J. Rondinone, B. G. Sumpter, S. M. Kilbey II, "Ternary behavior and systematic nanoscale manipulation of domain structures in P3HT/PCBM/P3HT-b-PEO films," *J. Mater. Chem.* **22**, 13013 (2012).
- Z. He, K. Xiao, D. Durant, J. E. Anthony, K. Hong, S. M. Kilbey, II, J. Chen, and D. Li, "Enhanced Performance Consistency in Nanoparticle/TIPS Pentacene-Based Organic Thin Film Transistors," *Advanced Functional Materials* **19**, 3617 (2011). *
- L. Luo, C. Wilhelm, C. N. Young, C. P. Grey,; G. P. Halada, K. Xiao, I. N. Ivanov, and J. Y. Howe, D. B. Geohegan, N. Goroff, "Characterization and Carbonization of Highly Oriented Poly(diiododiacetylene) Nanofibers," *Macromolecules* **44**, 2626 (2011).*
- Z. Sun; Xiao, K., J. K. Keum, X. Yu, K. Hong, I. Ivanov, J. Chen, D. Li, B. Sumpter, A. Payzant, C. Rouleau, and D. B. Geohegan, "PS-*b*-P3HT Copolymers as P3HT/PCBM Interfacial Compatibilizers for High Efficiency Photovoltaics," *Advanced Materials* **23**, 5529 (2011). *
- X. Yu, K. Xiao, J. Chen, N. V. Lavrik, K. Hong, B. G. Sumpter, and D. B. Geohegan, "High-Performance Field-Effect Transistors Based on Polystyrene-*b*-Poly(3-hexylthiophene) Diblock Copolymers," *ACS Nano* **5**, 3559 (2011).*
- M. A. Schreuder, K. Xiao, I. N. Ivanov, S. M. Weiss, and S. J. Rosenthal, "White Light-Emitting Diodes Based on Ultrasmall CdSe Nanocrystal Electroluminescence," *Nano Letters* **10**, 573 (2010).*
- K. Xiao, R. Li, J. Tao, E. A. Payzant, I. N. Ivanov, A. A. Poretzky, W. Hu, and D. B. Geohegan,

- “Metastable Copper-Phthalocyanine Single-Crystal Nanowires and Their Use in Fabricating High-Performance Field-Effect Transistors,” *Advanced Functional Materials* **19**, 3776 (2009).*
- K. Xiao, A. J. Rondinone, A. A. Puzos, I. N. Ivanov, S. T. Retterer, and D. B. Geohegan, “Growth, Patterning, and One-Dimensional Electron-Transport Properties of Self-Assembled Ag-TCNQ(4) Organic Nanowires,” *Chemistry of Materials* **21**, 4275 (2009).*
- R. Aggarwal, R. J. Narayan, K. Xiao, and D. B. Geohegan, “Fabrication of Ag-Tetracyanoquinodimethane Nanostructures Using Ink-jet Printing/Vapor-Solid Chemical Reaction Process,” *Journal of Vacuum Science and Technology B* **26**(6), L48 (2008).
- Z. Liu, D. J. Styers-Barnett, A. A. Puzos, C. M. Rouleau, D. Yuan, I. N. Ivanov, K. Xiao, and D. B. Geohegan, “Pulsed Laser CVD Investigations of Single-Wall Carbon Nanotube Growth Dynamics,” *Applied Physics A* **93**, 987 (2008).
- K. Xiao, J. Tao, A. A. Puzos, I. N. Ivanov, S. T. Retterer, S. J. Pennycook and D. B. Geohegan, “Selective Patterned Growth of Single-crystal Organic Nanowires of Ag-TCNQ by Vapor-Solid Chemical Reaction,” *Advanced Functional Materials* **18**, 3043 (2008).*
- K. Xiao, Y. Fu, Y. Liu, G. Yu, J. Zhai, L. Jiang, W. Hu, Z. Shuai, Y. Luo, and D. Zhu, “Photo-Electrical Characteristic of C/CN_x Multi-Walled Nanotube,” *Advanced Functional Materials* **17**, 2842 (2007).*
- K. Xiao, J. Tao, Z. Pan, A. A. Puzos, I. N. Ivanov, S. J. Pennycook, and D. B. Geohegan, “Single-Crystal Organic Nanowires of Cu-TCNQ: Synthesis, Patterning, Characterization and Device Applications,” *Angewandte Chemie International Edition* **46**, 2650 (2007).*
- Z. Zhou, K. Xiao, R. Jin, D. Mandrus, J. Tao, D. B. Geohegan, and S. Pennycook, “One-Dimensional Electron Transport in Cu-TCNQ Organic Nanowires,” *Applied Physics Letters* **90**, 193115 (2007).*
- Y. Sun, Y. Ma, Y. Liu, Y. Lin, Z. Wang, Y. Wang, C. Di, K. Xiao, X. Chen, W. Qiu, B. Zhang, G. Yu, W. Hu, and D. Zhu, “High-Performance and Stable Organic Thin-Film Transistors Based on Fused Thiophenes,” *Advanced Functional Materials* **16**, 426 (2006).*
- K. Xiao, I. N. Ivanov, A. A. Puzos, Z. Liu, and D. B. Geohegan, “Directed Integration of TCNQ-Cu Organic Nanowires Growth into Device Fabrication,” *Advanced Materials* **18**, 2184 (2006).*
- K. Xiao, Y. Liu, P. Hu, G. Yu, W. Hu, D. Zhu, X. Liu, H. Liu, and D. Wu, “Electronic Transport Characteristics of an Individual CN_x/C Nanotube Schottky Junction,” *Applied Physics A: Materials Science & Processing* **83**, 53 (2006).
- Y. Sun, Y. Ma, Y. Liu, Y. Lin, Z. Wang, Y. Wang, C. Di, K. Xiao, X. Chen, W. Qiu, B. Zhang, G. Yu, W. Hu, and D. Zhu, “High-Performance and Stable Organic Thin-Film Transistors Based on Fused Thiophenes,” *Advanced Functional Materials* **16**, 426 (2006).*
- W. Su, J. Jiang, K. Xiao, Y. Chen, Q. Zhao, G. Yu, and Y. Liu, “Thin-Film Transistors Based on Langmuir-Blodgett Films of Heteroleptic Bis(phthalocyaninato) Rare Earth Complexes”, *Langmuir* **21**, 6527 (2005).
- Y. M. Sun, K. Xiao, Y. Q. Liu, J. Wang, J. Pei, G. Yu, and D. B. Zhu, “Oligothiophene-Functionalized Truxene: Star-Shaped Compounds for Organic Field-Effect Transistor,” *Advanced Functional Materials* **15**, 818 (2005).*
- K. Xiao, Y. Liu, Y. G. Guo, G. Yu, L. Wan, and D. Zhu, “Influence of the Self-Assembly Monolayers on the Characteristics of Copper Phthalocyanine Thin Film Transistor,” *Applied Physics A: Materials Science & Processing* **80**, 1541 (2005).
- K. Xiao, Y. Liu, T. Qi, W. Zhang, F. Wang, J. Gao, W. Qiu, Y. Ma, G. Cui, S. Chen, X. Zhan, G. Yu, J. Qin, W. Hu, and D. Zhu, “A Highly π -Stacked Organic Semiconductor for Field-Effect Transistors Based on Linearly Condensed Pentathienoacene,” *Journal of the American Chemical Society* **127**, 13281 (2005).* (*Top 20 papers published in 2004-2007, Thomson Science Watch*)
- K. Xiao, Y. Q. Liu, P. A. Hu, G. Yu, Y. M. Sun, and D. B. Zhu, “n-Type Field-Effect Transistor Made of an Individual Nitrogen-Doped Multi-walled Carbon Nanotube,” *Journal of the American Chemical Society* **127**, 8614 (2005).*

- P. Hu, K. Xiao, Y.Q. Liu, G. Yu, X.B. Wang, L. Fu, and D. B. Zhu, "Multi-Wall Nanotubes with Intratube Junctions (CN_x/C): Preparation, Rectification, Logic Gates and their Application as a Wave-Detector in Transistor Radio Set", *Applied Physics Letter* **84**, 4932 (2004).*
- L. Fu, Y. Liu, P. Hu, K. Xiao, G. Yu, and D. Zhu, "Ga₂O₃ Nanoribbons: Synthesis, Characterization and Electronic Properties," *Chemistry of Materials* **15**, 4287 (2003).
- K. Xiao, Y. Q. Liu, P. A. Hu, G. Yu, X. B. Wang, and D. B. Zhu, "High-Mobility Thin-Film Transistors Based on Aligned Carbon Nanotubes," *Applied Physics Letters* **83**, 150 (2003).* Appears also in *Virtual Journal of Nanoscale Science & Technology* 8(2) (2003). (<http://www.vjnano.org/>)
- K. Xiao, Y. Q. Liu, X. B. Huang, Y. Xu, G. Yu, and D. B. Zhu, "Field-Effect Transistors Based on Langmuir-Blodgett Films of Phthalocyanine Derivatives as Semiconductor Layers," *Journal of Physical Chemistry B* **107**, 9226 (2003).*
- K. Xiao, Y. Q. Liu, P. A. Hu, G. Yu, L. Fu, and D. B. Zhu, "High Performance Field-Effect Transistors made of Multiwall CN_x/C Nanotube Intramolecular Junction," *Applied Physics Letters* **83**, 4824 (2003).* Appears also in *Virtual Journal of Nanoscale Science & Technology* **8**(12), (2003). <http://www.vjnano.org/>, (2003).
- K. Xiao, Y. Liu, G. Yu, and D. Zhu, "Influence of the Substrate Temperature During Deposition on Film Characteristics of Copper Phthalocyanine and Field-Effect Transistor Properties," *Applied Physics A: Materials Science & Processing* **77**, 367 (2003).
- K. Xiao, Y. Q. Liu, G. Yu, and D. B. Zhu, "Organic Field-Effect Transistors Using Copper Phthalocyanine Thin Film," *Synthetic Metals* **137**, 991 (2003).
- X. B. Wang, Y. Q. Liu, P. A. Hu, G. Yu, K. Xiao, and D. B. Zhu, "Controllable Fabrication of Three-Dimensional Carbon Nanotube Alignments," *Advanced Materials* **14**(21), 557 (2002).*
- K. Xiao, Y. Q. Liu, G. Yu, and D. B. Zhu, "Organic Field-Effect Transistors," *Chinese Science Bulletin* **47**, 881 (2002).
- K. Xiao, Y. G. Yan, L. C. Lei, Y. L. Du, "Application of Pd-Ag Alloy Diffusion Anode for Electrochemical Hydrogen Sensor," *Corrosion Science and Protection Technology* **14**, 125 (2002).
- L. C. Lei, K. Xiao, Y. Shen, X. Shi, Y. Gao, Y. L. Du, "Preparation and Characteristics of A Novel Imidazoline Inhibitor Made from Naphthenic Acid and Diethyl-tenetriamine," *Corrosion and Protection* **22**, 420 (2001).
- K. Xiao, Y. G. Yan, L. C. Lei, and Y. L. Du, "Studies of Solid State Electrolyte Hydrogen Sensors," *Corrosion Science and Protection technology* **13**, 165 (2001).
- J. R. Song, Z. X. Gong, M. B. Luo, and K. Xiao, "Study on the Performance of Adsorbing Uranium by Attapulgitic Clay," *Journal of East China Geological Institute* **21**, 265 (1998).