Jong Keum

Chemical and Engineering Materials Division/Center for Nanophase Materials Sciences, Oak Ridge National Laboratory

Education

PhD in Chemistry **9/2002 - 9/2007**
State University of New York at Stony Brook

MS in Chemistry **9/2002 - 9/2004**
State University of New York at Stony Brook

Research Interests

- Application of neutron/X-ray scattering techniques to studying structure of nanomaterials in solution, bulk and thin film
- 1D and 2D X-ray scattering modeling and model refinement.
- Processing-structure-electronic property of functional nanomaterials and nanocomposites
- Physics of polymer crystallization in solution and thin film

Research and Technical Experiences

Oak Ridge National Laboratory **1/2013 –**
Research and Technical Professional Staff, Instrument and Source Division/Center for Nanophase Materials Sciences

Oak Ridge National Laboratory **8/2010 – 1/2013**
Post Doctorate, Neutron Science Directorate

Case Western Reserve University **1/2008 - 7/2010**
Post Doctorate, Macromolecular Science & Engineering

Skills

- SANS, NR, XRD, XRR, (GI-) SAXS, (GI-) WAXS, powder/thin film XRD and Laue machine
- SANS at GP-SANS Beamline HFIR ORNL and EQ-SANS beamline SNS ORNL
- NR at Beamline 4B SNS ORNL
- Synchrotron SAXS/WAXS at X27C and X3A2 NSLS BNL USA, and 3C2 and 4C1 PAL S. Korea
- In-house SAXS instrumentation (Kratky and 3-pinhole camera).
- Wolfram Mathematica for scattering/reflectivity modeling and refinement.
- Igor Pro for data reduction/analysis.

- Thermal analysis: DSC and TGA.

Peer-Reviewed Papers

1. "Insights into the Morphology and Kinetics of Growth of Silver Metal-Organic Nanotubes". Thusitha Etampawala, Derek L Mull, **Jong K Keum**, David M Jenkins, Mark Dadmun. ***Crystal Growth & Design***, Accepted (**2016**), DOI: 10.1021/acs.cgd.5b01509.
2. "Li2OHCl Crystalline Electrolyte for Stable Metallic Lithium Anodes". Zachary D Hood, Hui Wang, Amaresh Samuthira Pandian, **Jong K Keum**, Chengdu Liang. ***Journal of the American Chemical Society*** 138, 1768 (**2016**)
3. "Fluorinated bottlebrush polymers based on poly (trifluoroethyl methacrylate): synthesis and characterization". Yuewen Xu, Weiyu Wang, Yangyang Wang, Jiahua Zhu, David Uhrig, Xinyi Lu, **Jong K Keum**, Jimmy W Mays, Kunlun Hong. ***Polymer Chemistry*** 7, 680 (**2016**).
4. "Correlating High Power Conversion Efficiency of PTB7:PC71BM Inverted Organic Solar Cells to Nanoscale Structure". Sanjib Das, **Jong K. Keum**, James F. Browning, Gong Gu, Bin Yang, Ondrej Dyck, Changwoo Do, Wei Chen, Jihua Chen, Ilia N. Ivanov, Kunlun Hong, Adam J. Rondinone, Pooran C. Joshi, David B. Geohegan, Gerd Duscher, Kai Xiao. ***Nanoscale*** 7, 15576 (**2015**)
5. "Controllable Growth of Perovskite Films by Room-Temperature Air Exposure for Efficient Planar Heterojunction Photovoltaic Cells". Bin Yang, Ondrej Dyck, Jonathan Poplawsky**,** **Jong K Keum**, Sanjib Das, Alexander Puretzky, Tolga Aytug, Pooran C Joshi, Christopher M Rouleau, Gerd Duscher, David B Geohegan, Kai Xiao. ***Angewandte Chemie International Edition*** 54, 14862 (**2015**)
6. "Perovskite Solar Cells with Near 100% Internal Quantum Efficiency Based on Large Single Crystalline Grains and Vertical Bulk Heterojunctions". Bin Yang, Ondrej Dyck, Jonathan Poplawsky, **Jong Keum**, Alexander Puretzky, Sanjib Das, Ilia N Ivanov, Christopher M Rouleau, Gerd Duscher, David B Geohegan, Kai Xiao. ***Journal of the American Chemical Society*** 137**,**9210 (**2015**)
7. "Enhancement in Organic Photovoltaic Efficiency through the Synergistic Interplay of Molecular Donor Hydrogen Bonding and π-Stacking". Nathan T Shewmon, Davita L Watkins, Johan F Galindo, Raghida Bou Zerdan, Jihua Chen, **Jong Keum**, Adrian E Roitberg, Jiangeng Xue, Ronald K Castellano. Advanced Functional Materials 25, 5166 (**2015**).
8. "The electrochemical reactions of SnO 2 with Li and Na: A study using thin films and mesoporous carbons". Joanna Górka, Loïc Baggetto, **Jong K Keum**, Shannon M Mahurin, Richard T Mayes, Sheng Dai, Gabriel M Veith. ***Journal of Power Sources*** 284, 1 (**2015**)
9. "Controlled Shape Memory Behavior of a Smectic Main-Chain Liquid Crystalline Elastomer". Yuzhan Li, Cole Pruitt, Orlando Rios, Liqing Wei, Mitch Rock, **Jong K Keum**, Armando G McDonald, Michael R Kessler. ***Macromolecules*** 48, 2864 (**2015**)
10. "Quantitative Phase Fraction Detection in Organic Photovoltaic Materials through EELS Imaging". Ondrej Dyck, Sheng Hu, Sanjib Das, **Jong Keum**, Kai Xiao, Bamin Khomami, Gerd Duscher. ***Polymers*** 7, 2446 (**2015**).
11. "Strong and Electrically Conductive Graphene Based Composite Fibers and Laminates". Ivan V Vlassiouk, Georgios Polizos, Ryan Cooper, Ilia N Ivanov, **Jong K Keum**, Felix Paulauskas, Panos G Datskos, Sergei N Smirnov. ***ACS applied materials & interfaces*** 7, 10702 (**2015**)
12. "Epitaxial stabilization and phase instability of VO2 polymorphs". Shinbuhm Lee, Ilia N. Ivanov, **Jong K. Keum**, Ho Nyung Lee. ***Scientific Reports*** 6, Article number: 19621 (**2015**). doi:10.1038/srep19621.
13. "Peculiarity of Two Thermodynamically-Stable Morphologies and Their Impact on the

Efficiency of Small Molecule Bulk Heterojunction Solar Cells". Nuradhika Herath, Sanjib Das, **Jong Keum**, Jiahua Zhu, Rajeev Kumar, Ilia Ivanov, Bobby Sumpter, James Browning, Kai Xiao, Gong Gu, Pooran Joshi, and Valeria Lauter. ***Scientific Reports*** 5, Article Number 13407 (**2015**). doi:10.1038/srep13407.

14. "Reciprocated suppression of polymer crystallization toward improved solid polymer electrolytes: Higher ion conductivity and tunable mechanical properties". Sheng Bi, Che-Nan Sun, Thomas A Zawodzinski, Fei Ren, **Jong Kahk Keum**, Suk-Kyun Ahn, Dawen Li, Jihua Chen. ***Journal of Polymer Science Part B: Polymer Physics*** 53, 1450 (**2015**)

15. "Nanostructure enhanced ionic transport in fullerene reinforced solid polymer electrolytes". Che-Nan Sun, Thomas A Zawodzinski, Wyatt E Tenhaeff, Fei Ren, **Jong Kahk Keum**, Sheng Bi, Dawen Li, Suk-Kyun Ahn, Kunlun Hong, Adam J Rondinone, Jan-Michael Y Carrillo, Changwoo Do, Bobby G Sumpter, Jihua Chen. ***Physical Chemistry Chemical Physics*** 17, 8266 (**2015**)

16. "Translational diffusion of water inside hydrophobic carbon micropores studied by neutron spectroscopy and molecular dynamics simulation". SO Diallo, L Vlcek, E Mamontov, **Jong K. Keum**, Jihua Chen, JS Hayes Jr, AA Chialvo. ***Physical Review E.*** 91, 022124 (**2015**)

17. "Understanding how processing additives tune nanoscale morphology of high efficiency organic photovoltaic blends: From casting solution to spun-cast thin film". Ming Shao, **Jong Kahk Keum**, Rajeev Kumar, Jihua Chen, James F. Browning, Wei Chen, Jianhui Hou, Changwoo Do, Kenneth C. Littrell, Sanjib Das, Adam Rondinone, David B. Geohegan, Bobby G. Sumpter, Kai Xiao. ***Advanced Functional Materials*** **24, 6647 (2014)**.

18. "The reaction mechanism of SnSb and Sb thin film anodes for Na-ion batteries studied by X-ray diffraction, ^{119}Sn and ^{121}Sb Mössbauer spectroscopies". Loïc Baggetto, Hien-Yoong Hah, Jean-Claude Jumas, Charles E. Johnson, Jacqueline A. Johnson, **Jong K. Keum**, Craig A. Bridges, Gabriel M. Veith. ***Journal of Power Source*** 267, 329 (**2014**).

19. "Improving performance of TIPS pentacene-based organic thin film transistors with small-molecule additives". Zhengran He, Jihua Chen, **Jong Kahk Keum**, Greg Szulczewski, Dawen Li. ***Organic Electronics*** 15 (1), 150 (**2014**).

20. "The isotopic effects of deuteration on optoelectronic properties of conducting polymers." Ming Shao, **Jong Keum**, Jihua Chen, Youjun He, Wei Chen, James F Browning, Jacek Jakowski, Bobby G Sumpter, Ilia N Ivanov, Ying-Zhong Ma, Christopher M Rouleau, Sean C Smith, David B Geohegan, Kunlun Hong, Kai Xiao. ***Nature Communications*** 5, 3180 (**2014**).

21. "Studies on Supercapacitor Electrode Material from Activated Lignin-Derived Mesoporous Carbon". Dipendu Saha, Yunchao Li, Zhonghe Bi, Jihua Chen, **Jong K Keum**, Dale Hensley, Hippolyte A Grappe, Harry M Meyer, Sheng Dai, Mariappan Parans Paranthaman, Amit K Naskar. ***Langmuir*** 30, 900 (**2014**).

22. "In situ determination of the liquid/solid interface thickness and composition for the Li-ion cathode LiMn1.5Ni0.5O4". James F. Browning, Loïc Baggetto, Katherine Jungjohann, Yongqiang Wang, Wyatt Tenhaeff, **Jong K Keum**, David Lee Wood, III, Gabriel M Veith. ***ACS Applied Materials & Interfaces*** 6, 18569 **(2014).**

23. "A High Conductive Oxide–Sulfide Composite Lithium Superionic Conductor". Ezhiylmurugan Rangasamy, Gayatri Sahu, **Jong Keum**, Adam Rondinone, Nancy Dudney, Chengdu Liang. ***Journal of Materials Chemistry A***. 2, 4111 (**2014**).

24. "Solvent-type-dependent polymorphism and charge transport in a long fused-ring organic semiconductor". Jihua Chen, Ming Shao, Kai Xiao, Adam J Rondinone, Yueh-Lin Loo, Paul RC Kent, Bobby G Sumpter, Dawen Li, **Jong K Keum**, Peter J Diemer, John E Anthony,

Oana D Jurchescu, Jingsong Huang. ***Nanoscale*** 6 (1), 449 (**2014**).

25. "Surface-Induced Orientation Control of CuPc Molecules for the Epitaxial Growth of Highly Ordered Organic Crystals on Graphene." Kai Xiao, Wan Deng, **Jong K Keum**, Mina Yoon, Ivan V Vlassiouk, Kendal W Clark, An-Ping Li, Ivan I Kravchenko, Gong Gu, Edward A Payzant, Bobby G Sumpter, Sean C Smith, James F Browning, David B Geohegan. ***Journal of American Chemical Society*** 135, 3680 (**2013**).
26. "Morphological origin for the stratification of P3HT:PCBM blend film studied by neutron reflectometry." **Jong Kahk Keum**, James F. Browning, Kai Xiao, Ming Shao, Candice E. Halbert, Kunlun Hong. ***Applied Physics Letters*** 103, 223301 (**2013**).
27. "Solvent quality-induced nucleation and growth of parallelepiped nanorods in dilute poly(3-hexylthiophene) (P3HT) solution and the impact on the crystalline morphology of solution-cast thin film". **Jong K Keum**, Kai Xiao, Ilia N Ivanov, Kunlun Hong, James F Browning, Gregory S Smith, Ming Shao, Kenneth C Littrell, Adam J Rondinone, E Andrew Payzant, Jihua Chen, Dale K Hensley. ***CrystEngComm*** 15, 1114 (**2013**).
28. "Bilayer self-assembly on a hydrophilic, deterministically nanopatterned surface". Gregory S Smith, Seung-Yong Jung, James F Browning, **Jong K Keum**, Nickolay V Lavrik, Mussie G Alemseghed, C Patrick Collier. ***Nano Research*** 6 (11), 784 (**2013**).
29. "Conjugated Polymer-Mediated Polymorphism of a High Performance, Small-Molecule Organic Semiconductor with Tuned Intermolecular Interactions, Enhanced Long-Range Order, and Charge Transport". Jihua Chen, Ming Shao, Kai Xiao, Zhengran He, Dawen Li, Bradley S Lokitz, Dale K Hensley, S Michael Kilbey, John E Anthony, **Jong K Keum**, Adam J Rondinone, Wen-Ya Lee, Sanghyun Hong, Zhenan Bao. ***Chemistry of Materials*** 25 (21), 4378 (**2013**)
30. "Germanium as negative electrode material for sodium-ion batteries". Loïc Baggetto, ***Jong K Keum***, James F Browning, Gabriel M Veith. ***Electrochemistry Communications*** 34, 41 (**2013**).
31. "Evidence for the formation of nitrogen-rich platinum and palladium nitride nanoparticles". Gabriel M Veith, Andrew R Lupini, Loïc Baggetto, James F Browning, **Jong K Keum**, Alberto Villa, Laura Prati, Alexander B Papandrew, Gabriel A Goenaga, David R Mullins, Steven E Bullock, Nancy J Dudney. ***Chemistry of Materials*** 25 (24), 4936 (**2013**).
32. "Flow-induced crystallization precursor structure in high molecular weight isotactic polypropylene (HMW-iPP)/low molecular weight linear low density polyethylene (LMW-LLDPE) binary blends". **Jong Kahk Keum**, Yimin Mao, Feng Zuo, Benjamin S Hsiao. ***Polymer*** 54 (4), 1425 (**2013**).
33. "High-performance organic field-effect transistors with dielectric and active layers printed sequentially by ultrasonic spraying". Ming Shao, Sanjib Das, Kai Xiao, Jihua Chen, **Jong K Keum**, Ilia N Ivanov, Gong Gu, William Durant, Dawen Li, David B Geohegan. ***Journal of Materials Chemistry C*** 23, 4384 (**2013**).
34. "PS-*b*-P3HT Copolymers as P3HT/PCBM Interfacial Compatibilizers for High Efficiency Photovoltaics". Zhenzhong Sun, Kai Xiao, **Jong Kahk Keum**, Xiang Yu, Kunlun Hong, Jim Browning, Ilia N Ivanov, Jihua Chen, Jose Alonzo, Dawen Li, Bobby G Sumpter, Edward A Payzant, Christopher M Rouleau, David B Geohegan. ***Advanced Materials*** 23, 5529 (**2011**).
35. "Confinement of elastomeric block copolymers via forced assembly coextrusion". Tiffani M Burt, **Jong Keum**, Anne Hiltner, Eric Baer, LaShanda TJ Korley. ***Appl. Mater. Interfaces*** 3, 4804 (**2011**).
36. "Fractionated crystallization of α-and β-nucleated polypropylene droplets". Deepak S Langhe,

Jong K. Keum, Anne Hiltner, Eric Baer. ***Journal Polymer Science Part B. Polymer Physics*** 49,159 (**2011**).

37. "Effect of Substrate on the Isothermal Crystallization Kinetics of Confined Poly (ε-caprolactone) Nanolayers". Michael Ponting, Yijian Lin, **Jong K Keum**, Anne Hiltner, Eric Baer. ***Macromolecules*** 43, 8619 (**2010**).

38. "Structure and properties of biaxial-oriented crystalline polymers by solid-state crossrolling". Y Yang, **J Keum**, Z Zhou, G Thompson, A Hiltner, E Baer. ***Journal of Applied Polymer Science*** 118, 659 (**2010**).

39. "Crystallization kinetics of poly (ethylene oxide) in confined nanolayers". Haopeng Wang, **Jong K Keum**, Anne Hiltner, Eric Baer. ***Macromolecules*** 43, 3359 (**2010**).

40. "Impact of nanoscale confinement on crystal orientation of poly (ethylene oxide)". Haopeng Wang, **Jong K Keum**, Anne Hiltner, Eric Baer. ***Macromolecular Rapid Communication*** 31, 356 (**2010**).

41. "Confined crystallization of polyethylene oxide in nanolayer assemblies". Haopeng Wang, **Jong K Keum**, Anne Hiltner, Eric Baer, Benny Freeman, Artur Rozanski, Andrzej Galeski. ***Science*** 423, 757 (**2009**).

42. "Crystallization behavior of isotactic propylene-1-hexene random copolymer revealed by time-resolved SAXS/WAXD techniques". Yimin Mao, Feng Zuo, **Jong Kahk Keum**, Benjamin S Hsiao, Derek W Thurman, Andy H Tsou. ***Journal of Polymer Science, Part B: Polymer Physics*** 48, 26 (**2009**).

43. "Confined crystallization of PEO in nanolayered films impacting structure and oxygen permeability". Haopeng Wang, **Jong K Keum**, Anne Hiltner, Eric Baer. ***Macromolecules*** 42, 7055 (**2009**).

44. "Formation and stability of shear-induced shish-kebab structure in highly entangled melts of UHMWPE/HDPE blendsz". **Jong Kahk Keum**, Feng Zuo, Benjamin S Hsiao. ***Macromolecules*** 41, 4766 (**2008**).

45. "Orientation-induced crystallization of poly (ethylene terephthalate) fibers with controlled microstructure". **Jong Kahk Keum**, Hye-Jin Jeon, Hyun Hoon Song, Jong-In Choi, Yang-Kug Son. ***Polymer*** 49, 4882 (**2008**).

46. "Probing nucleation and growth behavior of twisted kebabs from shish scaffold in sheared polyethylene melts by in situ X-ray studies". **Jong Kahk Keum**, Christian Burger, Feng Zuo, Benjamin S Hsiao. ***Polymer*** 48, 4511 (**2007**).

47. "Probing the flow-induced shish-kebab structure in entangled polyethylene melts by synchrotron X-ray scattering". **Jong Kahk Keum**, Feng Zuo, Benjamin S Hsiao. ***Journal of Applied Crystallography*** 40, s48 (**2007**).

48. "The role of interlamellar chain entanglement in deformation-induced structure changes during uniaxial stretching of isotactic polypropylene". Feng Zuo, **Jong Kahk Keum**, Xuming Chen, Benjamin S Hsiao, Hongyu Chen, Shih-Yaw Lai, Ronald Wevers, Jing Li. ***Polymer*** 48, 6867 (**2007**).

49. "Water soluble complexes of chitosan-g-MPEG and hyaluronic acid". Jun Wu, Xuefen Wang, **Jong Kahk Keum**, Hongwen Zhou, Mikhail Gelfer, Carlos-Alberto Avila-Orta, Hui Pan, Weiliam Chen, Shu-Min Chiao, Benjamin S Hsiao, Benjamin Chu. ***Journal of Biomedical Materials Research A***. 80A, 800 (**2007**).

50. "Thermal stability of shear-induced shish-kebab precursor structure from high molecular weight polyethylene chains". Feng Zuo, **Jong Kahk Keum**, Ling Yang, Rajesh H Somani,

Benjamin S Hsiao. ***Macromolecules*** 39, 2209 (**2006**).

51. "Probing flow-induced precursor structures in blown polyethylene films by synchrotron X-rays during constrained melting". **Jong Kahk Keum**, Rajesh H Somani, Feng Zuo, Christian Burger, Igors Sics, Benjamin S Hsiao, Hongyu Chen, Rainer Kolb, Ching-Tai Lue. ***Macromolecules*** 38(12), 5128 (**2005**).
52. "Synchrotron X-ray scattering studies of the nature of shear-induced shish-kebab structure in polyethylene melt". **JK Keum**, C Burger, BS Hsiao, R Somani, L Yang, B Chu, R Kolb, H Chen, CT Lue. ***Progress in Colloid & Polymer Science*** 130, 114 (2005).
53. "Thermal deformations of oriented noncrystalline poly (ethylene terephthalate) fibers in the presence of mesophase structure". **Jong Kahk Keum**, Hyun Hoon Song. ***Polymer*** 46, 939 (**2005**).
54. "In situ synchrotron SAXS/WAXD studies during melt spinning of modified carbon nanofiber and isotactic polypropylene nanocomposite". Shaofeng Ran, Christian Burger, Igors Sics, Kyunghwan Yoon, Dufei Fang, Kwangsok Kim, Carlos Avila-Orta, **Jongkahk Keum**, Benjamin Chu, Benjamin S Hsiao, David Cookson, Dave Shultz, Myungae Lee, Jim Viccaro, Yasuo Ohta.; Cookson, D; Shultz, D; Lee, M; Viccaro, J; Ohta, Y. ***Colloid and Polymer Science*** 282(8), 802 (**2004**).
55. "Crystallization and transient mesophase structure in cold-drawn PET fibers". **Jong Kahk Keum**, Jinmo Kim, Sang Man Lee, Hyun Hoon Song, Yang-Kug Son, Jong-In Choi, Seung Soon Im. ***Macromolecules*** 36, 9873 (**2003**).
56. "Deformation behavior of polyethylene/silicate nanocomposites as studied by real-time wide-angle X-ray scattering". Ki Hyun Wang, In Jae Chung, Min Cheol Jang, **Jong Kahk Keum**, Hyun Hoon Song. ***Macromolecules*** 35, 5529 (**2002**).

Book Chapters

1. Keum, *et al*. "Concepts for the Study of Structure and its Development-2 Anisotropic Materials-Synchrotron X-ray scattering studies of the nature of shear-induced shish-kebab structure in polyethylene melt". Scattering Methods and the Properties of Polymer Materials.
2. Chen, *et al*. "Nanophase Separation in Organic Solar Cells". CRC, Taylor & Francis. (**2015**)
3. Yang et al. "Organic Semiconductor-based Solar Cells" Springer Ser. Materials, Vol. 218 (**2015**)

Patent

- Chengdu Liang, **Jong Kahk Keum**, Adam J Rondinone, Nancy Dudney. "High Conducting Oxide-Sulfide Composite Lithium Superionic Conductor", US Patent 20, 150, 171,463. (2015).

Invited Talk

- X-ray and neutron small-angle scattering study on the interfacial morphology of organic photovoltaic thin film, **University of Cincinnati** (**2012**).

Awards and Honor

- Excellence in Doctoral Research (**2008**), State University of New York at Stony Brook.
- Distinguished Scientific Paper (**2014**), Center for Nanophase Materials Sciences.
- FY 2016 Laboratory Directed Research and Development (LDRD) Fund Granted.