# Jianguo Wen

Materials Scientist

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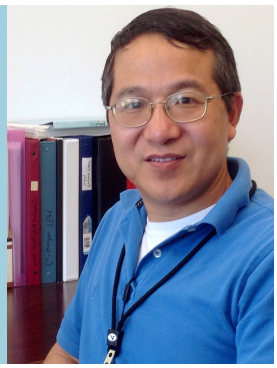

## Education

Ph. D. Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences, China
M. S. Metal Physics, Wuhan University, China
B. S. Physics, Wuhan University, China

## Research interests

- Development and application of spherical and chromatic aberration-corrected transmission electron microscopy techniques to solve materials problems in catalysts, battery materials, photovoltaic films, and ferroelectric, piezolectric, and superconducting oxide films etc. Another major research interest is carbon materials such as graphene, and nanotubes, and high-pressure synthesized diamond.

## Professional Experience

Argonne National Laboratory - Center for Nanoscale Materials (CNM) *2011-present*
Materials Scientist

- Development and application of chromatic aberration-corrected transmission electron microscopy techniques to characterize advanced energy materials such as catalysts, battery materials, photovoltaic materials, oxide films, and carbon.

University of Illinois at Urbana-Champaign - Frederick Seitz Materials Research Laboratory *2002-2011*
Scientist

- Application of advanced transmission electron microscopy techniques to characterize materials such as catalysts, battery materials, oxide films, hard-coating films etc.
- Development and application of various in-situ TEM holders to characterize materials in liquid, under biasing, or tensile force.

Boston College – Physics Department *2000-2002*
Research assistant professor

- Structural characterization using transmission electron microscopy for carbon nanotubes, ZnO nanomaterials, etc.

International Superconductivity Technology Center, Tokyo, Japan *1993-2000*
Senior Scientist

- Characterization of atomic structures in high-temperature superconductivity in crystals, films, and devices using transmission electron microscopy.

Delft University of Technology – Materials Science and Engineering, The Netherlands *1991-1993*
Post-doc

- Characterization of atomic structures at the interface between high-temperature superconductivity films and substrates using high-resolution electron microscopy.

## Selected Publications

Selected from 250+ publications:

### Cathode materials in Li-ion, Li-$O_2$, Na-ion batteries

1. Jun Lu, Yun Jung Lee, Xiangyi Luo, Kah Chun Lau, Mohammad Asadi, Hsien-Hau Wang, Scott Brombosz, **Jianguo Wen**, Dengyun Zhai, Zonghai Chen, Dean J Miller, Yo Sub Jeong, Jin-Bum Park, Zhigang Zak Fang, Bijandra Kumar, Amin Salehi-Khojin, Yang-Kook Sun, Larry A Curtiss, Khalil Amine, *A lithium–oxygen battery based on lithium superoxide*, Nature **529**, 377–382 (2016).
2. Dengyun Zhai, Kah Chun Lau, Hsien-Hau Wang, **Jianguo Wen**, Dean J Miller, Jun Lu, Feiyu Kang, Baohua Li, Wenge Yang, Jing Gao, Ernesto Indacochea, Larry A Curtiss, Khalil Amine, *Interfacial Effects on Lithium Superoxide Disproportionation in Li-$O_2$ Batteries,* Nano Lett. **15 (2)**, 1041-1046 (2015).
3. Jun Lu, Chun Zhan, Tianpin Wu, **Jianguo Wen**, Yu Lei, A Jeremy Kropf, Huiming Wu, Dean J Miller, Jeffrey W Elam, Yang-Kook Sun, Xinping Qiu, Khalil Amine, *Effectively suppressing dissolution of manganese from spinel lithium manganate via a nanoscale surface-doping approach*, Nature Comm. **5**, Article number: 5693 (2014).
4. Eungje Lee, Jun Lu, Yang Ren, Xiangyi Luo, Xiaoyi Zhang, **Jianguo Wen**, Dean Miller, Aaron DeWahl, Stephen Hackney, Baris Key, Donghan Kim, Michael D Slater, Christopher S Johnson, *Layered $P_2/O_3$ Intergrowth Cathode: Toward High Power Na-Ion Batteries*, Advanced Energy Materials **4 (17)**, 1400458 (2014).
5. Jun Lu, Lei Cheng, Kah Chun Lau, Eric Tyo, Xiangyi Luo, **Jianguo Wen**, Dean Miller, Rajeev S Assary, Hsien-Hau Wang, Paul Redfern, Huiming Wu, Jin-Bum Park, Yang-Kook Sun, Stefan Vajda, Khalil Amine, Larry A Curtiss, *Effect of the size-selective silver clusters on lithium peroxide morphology in lithium–oxygen batteries*, Nature Comm. 5, Article number: 4895, (2014).
6. Brandon R Long, Jason R Croy, Fulya Dogan, Matthew R Suchomel, Baris Key, **Jianguo Wen**, Dean J Miller, Michael M Thackeray, Mahalingam Balasubramanian, *Effect of Cooling Rates on Phase Separation in 0.5 $Li_2MnO_3$· 0.5 $LiCoO_2$ Electrode Materials for Li-Ion Batteries*, Chemistry of Materials **26 (11)**, 3565-3572 (2014).
7. Jun Lu, Yu Lei, Kah Chun Lau, Xiangyi Luo, Peng Du, **Jianguo Wen**, Rajeev S Assary, Ujjal Das, Dean J Miller, Jeffrey W Elam, Hassan M Albishri, D Abd El-Hady, Yang-Kook Sun, Larry A Curtiss, Khalil Amine, *A nanostructured cathode architecture for low charge overpotential in lithium-oxygen batteries*, Nature Comm. **4**, Article number: 2383 (2013).
8. J Bareno, M Balasubramanian, SH Kang, **JG Wen**, CH Lei, SV Pol, I Petrov, DP Abraham, *Long-range and local structure in the layered oxide $Li_{1.2}Co_{0.4}Mn_{0.4}O_2$*, Chemistry of Materials **23 (8)**, 2039-2050 (2011).
9. **JG Wen**, J Bareno, CH Lei, SH Kang, M Balasubramanian, I Petrov, DP Abraham, *Analytical electron microscopy of $Li_{1.2}Co_{0.4}Mn_{0.4}O_2$ for lithium-ion batteries*, Solid State Ionics **182 (1),** 98-107 (2011).
10. CH Lei, **JG Wen**, M Sardela, J Bareno, I Petrov, S-H Kang, DP Abraham, *Structural study of $Li_2MnO_3$ by electron microscopy, Journal of materials science* **44 (20)**, 5579-5587 (2009).

### Catalysts, catalyst supports, shape-defined nanomaterials

11. Wharton Sinkler, Sergio I Sanchez, Steven A Bradley, **Jianguo Wen**, Bhoopesh Mishra, Shelly D Kelly, Simon R Bare, *Aberration-Corrected Transmission Electron Microscopy and In Situ XAFS Structural Characterization of Pt/γ-$Al_2O_3$ Nanoparticles*, ChemCatChem **7 (22)**, 3779-3787 (2015).
12. Yuyuan Lin, Zili Wu, **Jianguo Wen**, Kunlun Ding, Xiaoyun Yang, Kenneth R Poeppelmeier, Laurence D Marks, *Adhesion and atomic structures of gold on ceria nanostructures: The role of surface structure and oxidation state of ceria supports*, Nano Lett. **15 (8)**, 5375-5381 (2015).
13. Wenpei Gao, Shankar Sivaramakrishnan, **Jianguo Wen**, Jian-Min Zuo, *Direct Observation of Interfacial Au Atoms on $TiO_2$ in Three Dimensions*, Nano Lett. **15 (4)**, 2548-2554 (2015).
14. Yuyuan Lin, Zili Wu, **Jianguo Wen**, Kenneth R Poeppelmeier, Laurence D Marks, *Imaging the atomic surface structures of $CeO_2$ nanoparticles*, Nano Lett. **14 (1)**, 191-196 (2013).
15. Yuyuan Lin, **Jianguo Wen**, Linhua Hu, Robert M Kennedy, Peter C Stair, Kenneth R Poeppelmeier, Laurence D Marks, Synthesis-dependent atomic surface structures of oxide nanoparticles, Phy. Rev. Lett. **111 (15),** 156101 (2013).

16. Amish B Shah, Sean T Sivapalan, Brent M DeVetter, Timothy K Yang, **Jianguo Wen**, Rohit Bhargava, Catherine J Murphy, Jian-Min Zuo, *High-index facets in gold nanocrystals elucidated by coherent electron diffraction*, Nano Lett. **13 (4)**, 1840-1846 (2013).
17. Sergio I Sanchez, Matthew W Small, Emil S Bozin, **Jian-Guo Wen**, Jian-Min Zuo, Ralph G Nuzzo, *Metastability and Structural Polymorphism in Noble Metals: The Role of Composition and Metal Atom Coordination in Mono-and Bimetallic Nanoclusters*, ACS Nano **7 (2)**, 1542-1557 (2013).
18. Yugang Sun, Yang Ren, Yuzi Liu, **Jianguo Wen**, John S Okasinski, Dean J Miller, *Ambient-stable tetragonal phase in silver nanostructures*, Nature Comm. **3**, 971 (2012).

### Complex oxides, ferroelectric, piezoelectric, superconducting films

19. Hongwei Wang, **Jianguo Wen**, Dean J Miller, Qibin Zhou, Mohan Chen, Ho Nyung Lee, Karin M Rabe, Xifan Wu, *Stabilization of Highly Polar $BiFeO_3$-like Structure: A New Interface Design Route for Enhanced Ferroelectricity in Artificial Perovskite Superlattices*, Phy. Rev. X **6 (1)**, 011027 (2016).
20. AB Shah, QM Ramasse, SJ May, Jerald Kavich, JG Wen, X Zhai, JN Eckstein, J Freeland, A Bhattacharya, JM Zuo, *Presence and spatial distribution of interfacial electronic states in $LaMnO_3$-$SrMnO_3$ superlattices,* Phy. Rev. B **82 (11)**, 115112 (2010).
21. Amish B Shah, Quentin M Ramasse, Xiaofang Zhai, **Jian Guo Wen**, Steve J May, Ivan Petrov, Anand Bhattacharya, Peter Abbamonte, James N Eckstein, Jian-Min Zuo, *Probing interfacial electronic structures in atomic layer $LaMnO_3$ and $SrTiO_3$ superlattices,* Adv. Mater. **22 (10)**, 1156-1160 (2010).
22. Amish B Shah, Xiaofang Zhai, Bin Jiang, **Jian-Guo Wen**, James N Eckstein, Jian-Min Zuo, *Electron energy-loss study of the electronic structure of atomic scale $SrTiO_3$– $SrMnO_3$– $LaMnO_3$ superlattices,* Phy. Rev. B **77 (11)**, 115103 (2008).

### In-situ TEM

23. Xin Chen, **Jianguo Wen**, *In situ wet-cell TEM observation of gold nanoparticle motion in an aqueous solution*, Nanoscale research letters **7 (1)**, 1-6 (2012).
24. X Chen, KW Noh, **JG Wen**, SJ Dillon, *In situ electrochemical wet cell transmission electron microscopy characterization of solid–liquid interactions between Ni and aqueous $NiCl_2$*, Acta Mater. **60 (1)**, 192-198 (2012).
25. L Sun, KW Noh, **JG Wen**, SJ Dillon, I*n situ transmission electron microscopy observation of silver oxidation in ionized/atomic gas*, Langmuir **27 (23)**, 14201-14206 (2011).
26. Ryan Franks, Sean Morefield, **Jianguo Wen**, Dongxiang Liao, Jorge Alvarado, Michael Strano, Charles Marsh, *A study of nanomaterial dispersion in solution by wet-cell transmission electron microscopy,* J. of Nanoscience and Nanotechnology 8 (9), 4404-4407 (2008).

### Carbon Materials

27. Sanket A Deshmukh, Badri Narayanan, Ganesh Kamath, Vilas G Pol, **Jianguo Wen**, Dean J Miller, Subramanian KRS Sankaranarayanan, *Nanoscale origin and evolution of kinetically induced defects in carbon spheres*, Carbon **96**, 647-660 (2016).
28. Vilas G Pol, **Jianguo Wen**, Kah Chun Lau, Samantha Callear, Daniel T Bowron, Chi-Kai Lin, Sanket A Deshmukh, Subramanian Sankaranarayanan, Larry A Curtiss, William IF David, Dean J Miller, Michael M Thackeray, *Probing the evolution and morphology of hard carbon spheres*, Carbon **68**, 104-111 (2014).

## Book Chapters

### Book Chapters

1. J. G. Wen, “Transmission Electron Microscopy", in the book “Practical Materials Characterization”, edited by Mauro R Sardela, 2014, Springer
2. J. G. Wen, “Microstructures of high-Tc superconducting Josephson junctions,” in the book, “Progress in Transmission Electron Microscopy 2: Applications in Materials”, edited by Xiao-Feng Zhang, Ze Zhang, 2001, Springer.
3. J. G. Wen, “Specimen preparation for transmission electron microscopy,” in the book “Characterization of high Tc materials and devices by electron microscopy”, Cambridge Univ Press 2000.

## Selected Patents

### Selected from 18 Patents

1. US 13/796,672 *Porous graphene nanocages for battery applications*, K Amine, J Lu, DU Peng, **JG Wen**, LA Curtiss, US Patent.
2. US 8059271 B2 *Reusable sample holding device permitting ready loading of very small wet samples* Charles P. Marsh, Eric Olson, Todor I. Donchev, Ivan Petrov, **Jianguo Wen**, Ryan Franks, Dongxiang Liao.
3. US 7147966 B2 *Coated carbon nanotube array electrodes* ZF Ren, **JG Wen**, JH Chen, ZP Huang, DZ Wang.
4. US 7157068 B2 *Feeding a carbon source gas into an oxygen-free chemical reactor containing catalyst particles/substrates*, Wenzhi Li, **Jianguo Wen**, Zhifeng Ren.
5. US 6911260 B2 *Reinforced carbon nanotubes* Z Ren, **JG Wen**, JY Lao, W Li, US Patent
6. US 20060057050 A1 *Synthesis of boron carbide nanoparticles*, Zhifeng Ren, **Jianguo Wen**, Jing Lao, Wenzhi Li, Shuo Chen,
7. US 6871528 B2 *Method of producing a branched carbon nanotube for use with an atomic force microscope*, Rudiger Schlaf, Zhifeng F Ren, **Jianguo Wen**, David L Carnahan.
8. US 5883051 A *High Tc superconducting Josephson junction element*, Y Ishimaru, **JG Wen**, K. Hayashi, Y. Enomoto, N. Koshizuka, S. Tanaka.
9. US 6541789 *B1 High temperature superconductor Josephson junction element and manufacturing method for the same*, Tetsuro Sato, **Jian-Guo Wen**, Naoki Koshizuka, Shoji Tanaka.