Zhe Qiang

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Education

Ph.D. 2016
Polymer Engineering, University of Akron, Akron, OH
Research Advisor: Dr. B. D. Vogt and Dr. K. A. Cavicchi

M.S. 2013
Polymer Engineering, University of Akron, Akron, OH
Research Advisor: Dr. B. D. Vogt and Dr. K. A. Cavicchi

B.S. 2012
Material Science and Engineering, Donghua University, Shanghai, China
Research Advisor: Dr. Y.Wang

Research Experience

Graduate Research September/2012-present
University of Akron, OH

1) Development of a novel, facile generalized method for block copolymer thin film alignment: solvent vapor annealing with shear (SVA-S)
- Mechanistic studies provide framework for generalization through solvent selection, solvent removal rate, and shape of elastomer
- Demonstrated fabrication of functional, highly aligned mesoporous carbon films and silica nanopatterns

2) Synthesis of functional block copolymer materials using reversible addition-fragmentation chain-transfer (RAFT) polymerization and atom transfer radical polymerization (ATRP)

3) Morphology control in soft-templated mesoporous carbon films through solvent processing
- Solvent vapor annealing enables decoupling of ordering and crosslinking for precursor stabilization to improve long range order
- Low volatility solvent additives provides scalable approach to fabricating highly ordered mesoporous carbon thin films with large pore size

4) Large-scale fabrication of highly ordered free-standing mesoporous films (including mesoporous carbon, mesoporous silica and mesoporous metal oxide) using roll-to-roll tools.
- Developed method for continuous fabrication of mesoporous materials
- Transforms organic-organic self-assembly approach to a feasible route for commercial mesoporous materials

5) Development of a facile method for fabrication of doped (N,S,B,P) porous carbon with controllable doping concentration
- Demonstrated fabrication a family of highly doped carbon (>20 at%) using simple, generalizable 'melt-diffusion' method

- Development of a wide variety of applications for such highly doped carbon materials especially in the field of energy storage (including Li-ion battery, Na-S battery, Na-ion battery, potassium-ion battery and biofuel absorbent)

6) In-situ morphological study of mesoporous metal oxide anode during charging and discharging

- In-situ GISAXS/GIWAXS for investigating the structural charge and pore deformation during cycling using customized battery cell
- Observation of stabilized mesoporous silica anode materials through carbon additives using in-situ X-ray scattering technique

Honors and Awards

Polymer Physics Poster Prize, American Physical Society 2016

Finalist, Frank J. Padden Jr. Award for Excellence in Polymer Physics Graduate Research, American Physical Society 2015

Eastman travel award 2014

Richard L. Waldman Jr. scholarship 2013

Publications

Patents

1. Long cycle stability metal-sulfur batteries using high nitrogen content surface modified porous carbon; US patent pending

Book Chapters

1. BD. Vogt, **Z. Qiang**, J. Xue, G. Deng, A. Karim and KA. Cavicchi "Structural control in block copolymer templated nanoporous carbon films" in Polymer Precursor Derived Carbon, 2014, *ACS Symposium Series,* Vol. 1173, chapter 3, 35-60.

Refereed Journals

21. Y. Chen, W. Liang, S. Li, F. Zou, S. Bhaway, **Z. Qiang**, M. Gao, BD. Vogt and Y. Zhu "Nitrogen doped carbonized metal organic framework for high stability room temperature sodium-sulfur battery" *Journal of Material Chemistry A*, just accepted

20. K. Lin, Y. Gu, H. Zhang, **Z. Qiang**, BD. Vogt and N. Zacharia "Localized microwave heating accelerates amidization of brached polyethylenimine (BPEI)/poly(acrylic acid) (PAA) multilayer films" *submitted*

19. K. Staggs, **Z. Qiang**, BD. Vogt and D. Nielsen "Characterization of magnetically responsive engineered mesoporous carbon for ABE component recovery" *submitted*

18. **Z. Qiang,** KA. Cavicchi and BD. Vogt "Roll-to-roll fabrication of N-doped mesoporous carbon with iron oxide nanoparticles for sodium-ion battery " *submitted*

17. **Z. Qiang,** KA. Cavicchi and BD. Vogt "Bimodal porous carbon-silica nanocomposites for low-cost, high rate, excellent cycle stability Li-ion batteries " *submitted*

16. **Z. Qiang,** Y. Chen, Y. Xia, W. Liang, Y. Zhu and BD. Vogt "Room temperature sodium-sulfur battery for over ten thousand cycles " *Advanced Materials, in revision*

15. S. Wang, **Z. Qiang**, KA. Cavicchi and BD. Vogt "Role of block copolymer composition and hydrophobic content on pore characteristics of micelle-templated mesoporous cobalt oxide films" *Langmuir*, 2016, 32(16), 4077-4085

14. **Z. Qiang,** B. Gurkan, J. Ma, X. Liu, Y, Guo, M. Cakmak, KA. Cavicchi and BD. Vogt "Roll-to-roll fabrication of high surface area mesoporous carbon with process-tunable pore texture for optimization of adsorption capacity of bulky organic dyes" *Microporous and Mesoporous Materials, 2016, 227, 57-64*

13. **Z. Qiang,** C. Ye, K. Lin, ML. Becker, KA. Cavicchi and BD. Vogt "Evolution in surface morphology during rapid microwave annealing of PS-b-PMMA thin films " *Journal of Polymer Science Part B: Polymer Physics, 2016, 54(15), 1499-1506*

12. **Z. Qiang,** M. Wadley, KA. Cavicchi and BD. Vogt "Facile non-lithographic route to sub-10 nm, highly aligned silica nanopatterns using unidirectionally aligned polystyrene-*block*-polydimethylsiloxane films" *Journal of Polymer Science Part B: Polymer Physics* 2015, 53(15), 1058-1064 (**Cover article**)

11. **Z. Qiang**, Y. Guo, H. Liu, SZD. Cheng, M. Cakmak, KA. Cavicchi and BD. Vogt "Large scale roll-to-roll fabrication of mesoporous materials" *ACS applied materials & Interfaces* 2015, 7(7), 4306-4310

10. Y. Zhang, **Z. Qiang** and BD. Vogt "Relationship between crosslinking and ordering kinetics for the fabrication of soft template (FDU-16) mesoporous carbon thin films" *RSC advance* 2014, 4, 44858-44867

9. **Z. Qiang**, Y. Zhang, Y. Wang, S. Bhaway, KA. Cavicchi and BD. Vogt "Highly aligned, large pore ordered mesoporous carbon film by solvent vapor annealing" *Carbon* 2015, 82, 51-59

8. G. Deng, Y. Zhang, C. Ye, **Z. Qiang**, GE. Stein, KA. Cavicchi and BD. Vogt "Bicontinuous mesoporous carbon thin film via an order-order transition" *Chemical communication* 2014,50,12684-12687

7. **Z. Qiang**, Y. Zhang, JA. Groff, KA. Cavicchi and BD. Vogt "A generalized method for alignment of block copolymer films: solvent vapor annealing with soft shear" *Soft matter* 2014 10(32), 6068-6076 **(Most read articles in July 2014)**

6. G. Deng, **Z. Qiang**, W. Lecorchick, KA. Cavicchi and BD. Vogt "Nanoporous nonwoven fibril-like morphology by cooperative self-assembly of poly(ethylene oxide)-block-poly(ethyl acrylate)-block-polystyrene and phenolic resin" *Langmuir* 2014 30(9), 2530-2540

5. **Z. Qiang**, L. Zhang, GE. Stein, KA. Cavicchi and BD. Vogt "Unidirectional alignment of block copolymer films induced by expansion of a permeable elastomer during solvent vapor annealing" *Macromolecules* 2014 47(3), 1109-1116

4. J. Xue, G. Singh, **Z. Qiang**, KG. Yager, A. Karim and BD. Vogt "Facile control of long range orientation in mesoporous carbon films with thermal zone annealing velocity" *Nanoscale* 2013, 5(24), 12440-12447

3. J. Xue, G. Singh, **Z. Qiang**, A. Karim and BD. Vogt "Unidirectional self-assembly of soft template mesoporous carbon by zone annealing" *Nanoscale* 2013, 5(17), 7928-7935

2. **Z. Qiang**, J. Xue, GE. Stein, KA. Cavicchi and BD. Vogt "Control of ordering and structure in soft-templated mesoporous carbon films by use of selective solvent additives" *Langmuir* 2013, 29(27), 9703-8712

1. **Z. Qiang**, J. Xue, KA. Cavicchi and BD. Vogt "Morphology control in mesoporous carbon films using solvent vapor annealing" *Langmuir* 2013, 29(10), 3428-3438

Contributed Presentations

14. **Z. Qiang**, BD. Vogt "In-situ X-ray observation of metal oxide anodic film during charging and discharging" Oral presentation at Materials Research Society, Phoenix, March 2016

13. BD. Vogt, **Z. Qiang**, KA. Cavicchi "Simple, generalizable route to functional films from polymer blends" Oral presentation at American Physical Society, Baltimore, March 2016 (**Invited talk**)

12. **Z. Qiang**, KA. Cavicchi, BD. Vogt "Rapid microwaving fabrication of perpendicularly oriented PS-b-PMMA thin films" Oral presentation at American Physical Society, Baltimore, March 2016

11. **Z. Qiang**, KA. Cavicchi, BD. Vogt "Simple, generalizable route to highly aligned block copolymer thin films" Oral presentation at American Physical Society, San Antonio, March 2015 (**Frank. Padden Award Symposium**)

10. **Z. Qiang**, KA. Cavicchi, BD. Vogt "Macroscopic alignment of block copolymers using solvent vapor annealing with soft shear" Oral presentation at Material Research Society, Boston, December 2014

9. KA. Cavicchi, G. Deng, **Z. Qiang**, BD. Vogt "Nanoporous carbons films templated with block copolymers" Oral presentation at American Chemical Society, San Francisco, August 2014

8. BD. Vogt, **Z. Qiang**, KA. Cavicchi "Roll-to-roll fabrication of functional porous materials via cooperative assembly with block copolymers" Oral presentation at American Chemical Society, San Francisco, August 2014

7. **Z. Qiang**, Y. Zhang, Y. Wang, KA. Cavicchi, BD. Vogt "Highly aligned mesoporous carbons from cooperative assembly of block copolymers and solvent vapor annealing with soft shear" Poster presentation at Gordon Research Conference, Mount Holyoke College, July 2014

6. **Z. Qiang**, L. Zhang, Y. Zhang, JA. Groff, GE. Stein, BD. Vogt, KA. Cavicchi "A generalized method of block cpolymer film alignment: solvent vapor annealing with soft shear" Poster presentation at Gordon Research Conference, Mount Holyoke College, July 2014

5. **Z. Qiang**, KA. Cavicchi, BD. Vogt "A generalized method of block cpolymer film alignment: solvent vapor annealing with soft shear" Oral presentation at Gordon Research Seminar, Mount Holyoke College, July 2014

4. **Z. Qiang**, KA. Cavicchi, BD. Vogt "Unidirectional alignment of block copolymer template porous films using solvent vapor annealing with soft shear" Oral presentation at American Physical Society, Denver, March 2014

3. BD. Vogt, **Z. Qiang**, KA. Cavicchi "Block copolymer alignment by shear induced during solvent vapor annealing with a crosslinked elastomer capping layer" Oral presentation at American Physical Society, Denver, March 2014 (**Invited talk**)

2. BD. Vogt, **Z. Qiang**, KA. Cavicchi "Controlled long range orientation of block copolymer nanostructures through soft confinement solvent vapor annealing"; Oral presentation at American Institute of Chemical Engineers, San Francisco, November 2013.

1. BD. Vogt, **Z. Qiang**, J. Xue, KA. Cavicchi, A. Karim "Processing effects on the morphology of mesoporous carbon films fabricated by cooperative self-assembly of phenolic resins"; Oral presentation at American Chemical Society, New Orleans, April 2013.