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EDUCATION

Postdoc Researcher	Lawrence Berkeley National Lab	
PI: Gerbrand Ceder	Material Science Division	Aug,2017
Research Topic: <i>Mechanical problems in dendrites growth at anode/solid electrolyte interface, and in composite cathode of solid-state batteries</i>		~Present
PhD	University of California Berkeley	
Advisors: Shaofan Li & Baoxia Mi	Civil and Environment Engineering	Sep,2012
Dissertation: <i>A computational & experimental study on 2D-material based membrane used for water purification/desalination</i>		~Jun,2017
MS/BS	Beijing Institute of Technology, China	Sep,2009
	Mechanical Engineering	~Dec,2011

RESEARCH EXPERIENCE (Details in Research Statement)

Mechanical Problems in Energy Storage Systems **Jun,2017~Present**

Topic 1: Illustrating the mechanical stability for dendrites growth in Li-metal solid-state battery.

- ◆ Continuum theories (Finite element and Phase field) were used to solve electro-chemo-mechanical coupled equations.
- ◆ Initiated 3 interdisciplinary collaborations and 3 high impact publications.
- ◆ Funded by DOE-EERE award (~\$200K/year) and successfully got awarded by Berkeley Lab LDRD 2020 (~\$180K).

Topic 2: Investigating an optimized design of composite cathode for solid-state battery.

- ◆ Granular mechanics and percolation theory were employed to study effects from particle size, cathode loading, applied pressure, tortuosity and porosity in the cathode.
- ◆ Initiated 3 collaborations with molecular foundry of LBNL, mechanical engineering of UCB and Bruker Corporation, 2 high impact publications and 1 U.S. provisional patent.
- ◆ Funded by Samsung Advanced Institute of Technology (~\$800K/year).

Topic 3: Developing a framework (Battery Simulator) for the design of solid-state batteries.

- ◆ Electro-chemo-mechanical coupling physics involved in solid-state batteries are integrated within the framework of finite element method.
- ◆ Built up a team to develop the package with two graduate students.
- ◆ Funding can be from government award (such as DOE-EERE) or industry (such as Samsung).

Mechanical Problems in Water Purification/Desalination Systems **Jun,2014~Present**

Topic 1: Illustrating transport mechanism in Graphite Oxide membrane within aqueous solutions.

- ◆ Molecular dynamics (Lammps package) was used to study the kinetics, the ionic mobility in GO channels and the solubility of GO in different solvents.

- ◆ Collaborated with one experimental team from environmental engineering of UCB and one characterizing team from LBNL.
- ◆ Funded by NSF-CBET and lead to 4 high impact publications.

Topic 2: Investigating the filtration and heavy-metal removal of MoS₂ Nanosheets.

- ◆ Density functional theory (Vasp package) was used to simulate the redox reactions and absorption of heavy-metal ions within MoS₂ membranes.
- ◆ Collaborated with teams from UCB and LBNL. Funded by DOE-Department of Environment, and published 3 high impact papers.

Topic 3: Designing a theoretical desalination system with rotating carbon nanotube.

- ◆ Proof of concept simulations with millions of atoms using MD show that this new centrifugal system has high separation capacity and low self-fouling ability.
- ◆ Published 4 high impact papers. Potential funding can be from NSF-CBET and DOE-DE.

Earlier Works on Mechanics of Materials

Sep,2012~Jun,2017

Topic 1: Developed a new numerical method to solve multiphase interfacial flow. Peridynamics method was employed to solve the Navier-Stokes equations, which is able to deal with water bubble motion in liquid and underwater explosion in confined space.

Topic 2: Studied size effects in high-temperature nanoindentation for fluorite material. Indenter sizes during nanoindentation experiments were found to affect the pop-in load at different temperature. Atomic calculations are conducted to show the mechanism.

Topic 3: Estimated the effective material properties of the composite nanomaterial with an improved double-inclusion homogenization model.

TEACHING EXPERIENCE

Graduate	Taught Time	Evaluation
Introduction to Computational Nano-mechanics	Spring,2017	4.6/5
Introduction to Computational Micro-mechanics	Fall,2015	4.58/5
Undergraduate	Taught Time	Evaluation
Introduction to Solid/Structural Mechanics	Spring,2016	4.51/5
Introduction to Engineering Programming	Spring,2015	4.45/5
Introductory Physics	Spring,2014	4.22/5

MENTORSHIP EXPERIENCE

- ◆ Mentoring one PhD student on fracture mechanics in solid state battery, and publish one paper (under-view paper #2).
- ◆ Mentoring one Master student on atomic calculations & nanoindentation, published two papers as corresponding author (peer-viewed paper #8-9).
- ◆ Supervising a team of high-school students on atomic simulation on water desalination, published two papers as corresponding author (peer-viewed paper #12-13).

PUBLICATIONS & PRESENTATIONS & PATENTS

◆ Peer-Reviewed Journal Articles

1. Tan Shi*, **Qingsong Tu*** (Co-first), et al. " High Active Material Loading in All-Solid-State Battery Electrode via Particle Size Optimization." *Accepted by **Advanced Energy Materials***.
2. Wang Z.*, **Qingsong Tu*** (Co-first), Zheng, S., Urban, J. J., Li, S., & Mi, B. (2017). Understanding the Aqueous Stability and Filtration Capability of MoS₂ Membranes. *Nano letters*, 17(12), 7289-7298.
3. Zheng Sunxiang, **Qingsong Tu**, Jeffrey J. Urban, Shaofan Li, and Baoxia Mi. "Swelling of graphene oxide membranes in aqueous solution: characterization of interlayer spacing and insight into water transport mechanisms." *ACS nano* 11, no. 6 (2017): 6440-6450.
4. **Qingsong Tu**, Qiang Yang, Hualin Wang, and Shaofan Li. "Rotating carbon nanotube membrane filter for water desalination." *Scientific reports* 6 (2016).
5. **Qingsong Tu**, and Shaofan Li. "An updated Lagrangian particle hydrodynamics (ULPH) for Newtonian fluids." *Journal of Computational Physics* 348 (2017): 493-513.
6. **Qingsong Tu**, et al. "A scale-up nanoporous membrane centrifuge for reverse osmosis desalination without fouling." *Technology* 6.01 (2018): 36-48.
7. Mi Baoxia, Sunxiang Zheng, and **Qingsong Tu**. "2D Graphene Oxide Channel for Water Transport." *Faraday Discussions* (2018).
8. Janel C., and **Qingsong Tu*** (Corresponding). "Molecular Dynamics Study of Crosslinked Phthalonitrile Polymers: Effect of Crosslink Density on Thermomechanical Dielectric Properties. *Polymers* 10 (2018): 64
9. Chua Janel, and **Qingsong Tu*** (Corresponding), et al. "High-Temperature Nanoindentation Size Effect in Fluorite Material" *International Journal of Mechanical Sciences* (2019).
10. Zheng Sunxiang, **Qingsong Tu**, Baoxia Mi. "Heterostructure membranes made from stacked two dimensional nanomaterials: Tuning the interlayer-spacing for aqueous phase separation." *THE AMERICAN CHEMICAL SOCIETY*. Vol. 255. 1155 16TH ST, NW, WASHINGTON, DC 20036 USA: AMER CHEMICAL SOC, 2018.
11. Li Tiange, **Qingsong Tu**, and Shaofan Li. "Molecular dynamics modeling of nano-porous centrifuge for reverse osmosis desalination." *Desalination* (2017).
12. **Qingsong Tu**, et al. "Study of the effect of osmotic pressure on the water permeability of carbon-based two-dimensional materials." *Computational Materials Science* 150 (2018): 9-14.
13. **Qingsong Tu**, Michelle Lee, Samuel Zhang, and Shaofan Li. "Molecular dynamics simulations of ions diffusion in carbon nanotubes embedded in cell membrane." *Comput. Model Eng. Sci* 98 (2014): 247-259.
14. Shi, Chunxiang, **Qingsong Tu**, Houfu Fan, and Shaofan Li. "An interphase model for effective elastic properties of concrete composites." *Journal of Micromechanics and Molecular Physics* (2016): 1650005.
15. Shi, Chunxiang, **Qingsong Tu**, Carlos AO Rios, and Shaofan Li. "Interphase Models for Nanoparticle-Polymer Composites." *Journal of Nanomechanics and Micromechanics* 6, no. 2 (2016): 04016003.
16. **Qingsong Tu**, et al. "Magnetic memory signals on surface defect of ferromagnetic specimen under plastic deformation condition." *Digital Manufacturing and Automation (ICDMA), 2010 International Conference on*. Vol. 1. IEEE, 2010.
17. Yin Liang, **Qingsong Tu**, et al. "Study of electrochemical finishing with magnetic field and high-frequency group pulse." *Digital Manufacturing and Automation (ICDMA), 2010 International Conference, IEEE*, 2010.
18. **Qing-song TU**, et al. "Study into Three-Dimensional Weak Magnetic Signal of Bolted Connection Under Static Tension Condition." *Transactions of Beijing Institute of Technology* 10 (2010): 006.
19. **Qing-Song Tu**, et al. "Magnetic Memory Testing on Detecting Stress Distribution of Mechanical Components with Weak Ferromagnetism." *Advanced Science Letters* 12.1 (2012): 73-77.

20. **Qingsong Tu**, and Weimin Zhang. "Study of Stress-Magnetism Coupling Feature on Bolted Connections under Static Tensile Condition." *International Conference on Measurement and Control Engineering 2nd (ICMCE 2011)*. ASME Press, 2011.
21. Liu Yi, **Qing-song TU**, et al. "Achieving enhanced denitrification via hydrocyclone treatment on mixed liquor recirculation in the anoxic/aerobic process." *Chemosphere* 189 (2017): 206-212.

◆ Journal Articles under Review

1. **Qingsong Tu**, et al. " Modeling of Electro-deposition and Mechanical Stability at Li Metal/Solid Electrolyte Interface during Plating in Solid-State Batteries." *Submitted to **Cell Reports Physical Science***.
2. Luis Barroso-Luque, **Qingsong Tu**, et al. " An Analysis of Solid-State Electrodeposition-Induced Metal Plastic Flow & Predictions of Stress States in Solid Ionic Conductor Defects." *Submitted to **Advanced Energy Materials***.
3. **Qingsong Tu**, et al. " Mechanical measurement and theoretical studies of the disintegration of NMC particles." *In preparation*.
4. Zheng Sunxiang*, **Qingsong Tu*** (Co-first), et al. " From Solubility to Swelling of Graphene Oxide in Organic Solvent: Characterization of Interlayer Spacing and Solvent Transport." *Submitted to **ACS Nano***.
5. Wang Zhongying*, **Qingsong Tu*** (Co-first), et al. " Super-selective Lead Removal by Two-Dimensional MoS₂ Nanosheets and Membranes." *Submitted to **Advanced Materials***.
6. **Qingsong Tu**, Shaofan Li, et al. " A Molecular Dynamics Study on Rotational Nanofluid and its Application to Desalination." *Submitted to **Desalination***.

◆ Conference Presentations

1. "Solid Electrolytes Particle Size Effect in All-Solid-State Batteries." Material Research Society, Boston, MA, Nov 24, 2018.
2. "First Principles Modeling and Design of Solid-State Interfaces for the Protection and use of Li Metal Anodes." Battery Material Research Modeling Meeting, UC Berkeley, CA, Sep 25, 2018
3. "Dendrite Modeling in All-Solid-State Battery." Vehicle Technologies Office Annual Merit Review, Washington DC, US, June 18, 2018.
4. "An Updated Lagrangian Particle Hydrodynamics (ULPH) for Newtonian Fluids." 14th U.S. National Congress on Computational Mechanics, Montreal, Canada, July 22, 2017.
5. "A non-local updated Lagrangian method for fluid dynamics". *Berkeley/Stanford Compfest 2017, UC Berkeley*, April 9, 2017.
6. "A new Peridynamic formulation for bubbly flows studies in three dimensions." *World Congress on Computational Mechanics, South Korea*, July 19, 2016.
7. "Nonlocal fluid method for 2D underwater explosion." *International Conference on Computational Methods, UC Berkeley*, August 10, 2016.

◆ PATENTS

1. Tan Shi, **Qingsong Tu**, Gerbrand Ceder. 2018. Effect of particle size in All-Solid-State Battery. Provisional patent filed on April, 2019.
2. Shuxuan Liu, Weimin Zhang, Liang Yin, **Qingsong Tu**, Zhang Fan, Qianpeng Gao. 2012. Testing method and device for gear destruction. CN101923070A, filed Dec 22, 2010, and issued Apr 18, 2012.

AWARDS AND HONORS

WCCM (World Congress on Computational Mechanics) paper award	Jul,2016
Department Award for Nano Research	Fall,2016
Berkeley Summer Research Grant	Summer,2015
University Annual Highest Prize – “Xu Teli” Award	Dec, 2010
Second Prize of National Mechanical Innovational Design in China	Jun, 2009

PROFESSIONAL SERVICE

Journal Article Reviewer

Science Advance, Small, Energy Storage Materials, Journal of Membrane Science, Journal of Macromolecular Science (part A), International Journal of Heat and Mass Transfer, Journal of Fluids Engineering, Journal of Structural Engineering, Mechanics of Advanced Materials and Structures, Journal of Theoretical Biology, Journal of Biomedical Science and Engineering, J. of Micromechanics and Molecular Physics, Journal of Micro- and Nano-Manufacturing.

Academic Organization

- ◆ Co-organizer “Water Resources, Pollution, Remediation and Energy Policy”, Chinese Environmental Scholars Forum, May 20-21, 2017
- ◆ Co-organizer “Entrepreneurship, Renewable Energy, Big Data, Robotics & AI”, Berkeley Chinese Summit, Oct 19, 2016
- ◆ President Chinese Visiting and Scholar Association, University of California Berkeley, 2014-2015

Outreach Activities

- ◆ Science Communicator K-12 STEM Education Program for next-generation scientists/engineers, Lawrence Berkeley Lab, July, 2019.
- ◆ Organizer & Designer Workshop on Computational Nano-mechanics & Water desalination, Computational Nano & Soft Material Lab, Summer, 2014~2015.
- ◆ Manager STEM and Innovative Programs for International High-School Students, UC Berkeley Extension, Summer, 2016~2017.