

Ananya Renuka Balakrishna
77 Massachusetts Avenue, 13-4061
MIT, Cambridge MA 02139
ananyarb@mit.edu, ananyabalakrishna.com

RESEARCH INTERESTS	I develop mathematical (phase-field) models to investigate the link between material microstructures and properties in energy storage and functional materials.	
PROFESSIONAL APPOINTMENT	University of Minnesota , Minneapolis, MN, USA Postdoctoral Researcher in Aerospace Engineering and Mechanics PI: Richard D. James Project: Direct conversion of heat to electricity using ferroelectric oxides <ul style="list-style-type: none">• Investigating energy conversion using the thermo-electro-mechanical coupling in ferroelectrics• Developing phase-field model to explore direct conversion of heat to electricity• Designing energy harvesters to harness thermal runaways in electronic devices	Oct. 2018 – present
	Massachusetts Institute of Technology , Cambridge, MA, USA Postdoctoral Fellow in Materials Science and Engineering PIs: W. Craig Carter, Yet-Ming Chiang Project: Combining Cahn-Hilliard and phase-field-crystal models for intercalation electrodes <ul style="list-style-type: none">• Investigated how crystallographic texture of electrodes affects Li kinetics and electrode strength• Developed multi-scale model to explore coupling between Li-diffusion & electrode crystallography• Demonstrated that battery cycling accelerates grain growth in electrodes and makes them brittle	Nov. 2016 – 2018
EDUCATION	University of Oxford , Oxford, OX, UK DPhil in Solid Mechanics and Materials Engineering Advisor: John E. Huber Thesis: Application of a phase field model to ferroelectrics <ul style="list-style-type: none">• Investigated how microstructural patterns of ferroelectrics affects its energy conversion• Developed phase-field model to explore ferroelectric microstructure evolution under external loads• Computationally designed nanoscale ferroelectric device concepts (actuators & energy harvesters)	2016
	National Institute of Technology Karnataka , Surathkal, India B. Tech in Mechanical Engineering Best Student Award	2012
AWARDS & HONORS	Data Incubator Fellowship (Finalist)	2018
	Brasenose Senior Hulme Scholarship (PhD academic excellence)	2016
	Falling Walls London Lab Winner	2014
	Felix Graduate Scholarship (5 awarded across India)	2012
	Cambridge International & Commonwealth Trust (Honorary scholar)	2012
	DAAD-WISE Fellowship (Undergraduate Research)	2011

GRANTS &
FELLOWSHIPS

Lindemann Postdoctoral Fellowship (\$40,000) <i>3 awarded across the UK each year</i>	2016
British Federation of Women Graduates Award (£2000) <i>Awarded among 377 applicants all over UK to further PhD research</i>	2015
Brasenose College grants (£2500) <i>University of Oxford</i>	2015
Graduate student travel grant (€500) <i>Administered by PIRE and NSF</i>	2015
Santander academic travel grant (£1000) <i>Santander Bank</i>	2015

PUBLICATIONS

- [10] **Renuka Balakrishna A**, Chiang Y-M, and Carter WC. 2018. Li-diffusion accelerates grain growth in intercalation electrodes: a phase-field study. Under review. arXiv:1806.06890
- [9] Bucci G, Talamini B, **Renuka Balakrishna A**, Chiang Y-M, and Carter WC. 2018. Mechanical instability of electrode-electrolyte interfaces in solid-state batteries. *Physical Review Materials*, 2(10), 105407. 10.1103/PhysRevMaterials.2.105407.
- [8] **Renuka Balakrishna A** and Carter WC. 2018. Combining phase field crystal methods with a Cahn-Hilliard model for binary alloys. *Physical Review E*, 97(4), 043304. 10.1103/PhysRevE.97.043304
- [7] Muench I, **Renuka Balakrishna A**, and Huber JE. 2018. Simulation of periodic, 3D domain patterns in tetragonal ferroelectrics. *Archive of Applied Mechanics*. 10.1007/s00419-018-1411-9
- [6] **Renuka Balakrishna A**, Huber JE, and Muench I. 2016. Nanoscale periodic domain patterns in tetragonal ferroelectrics: A phase-field study. *Physical Review B* 93 (17), 174120. 10.1103/PhysRevB.93.174120
- [5] **Renuka Balakrishna A** and Huber JE. 2016. Nanoscale domain patterns and a concept for an energy harvester. *Smart Materials and Structures* 25 (10), 104001. 10.1088/0964-1726/25/10/104001
- [4] **Renuka Balakrishna A** and Huber JE. 2015. Scale effects and the formation of polarisation vortices in tetragonal ferroelectrics. *Applied Physics Letters* 106 (9), 092906. 10.1063/1.4913917
- [3] **Renuka Balakrishna A**, Muench I, and Huber JE. 2015. Study of periodic domain patterns in tetragonal ferroelectrics using phase-field methods. *Proceedings of ASME SMASIS conference*, Colorado Springs, USA. 10.1115/SMASIS2015-8823
- [2] **Renuka Balakrishna A**, Huber JE, and Landis CM. 2014. Nano-actuator concepts based on ferroelectric switching. *Smart Materials and Structures* 23 (8), 085016. 10.1088/0964-1726/23/8/085016
- [1] **Renuka Balakrishna A** and Huber JE. 2014. Design optimisation of ferroelectric nano-actuator using phase field methods. *Proceedings of MRS conference*, San Francisco, USA. 10.1557/opl.2014.545

MANUSCRIPTS IN
PREPARATION

- [12] **Renuka Balakrishna A**, Tang M, Carter WC, Chiang Y-M. Intercalation induced mechanical failure of olivine compounds.
- [11] Christensen CK, **Renuka Balakrishna A**, Tang M, Iversen BB, Chiang Y-M, Ravnsbaek DB. Amorphization mechanism during Li-intercalation in TiO₂ electrode materials.

INVITED TALKS

[2] “Phase field modeling of microstructural evolution”, Aerospace Engineering and Mechanics Research Seminar, University of Minnesota, MN, 2017

[1] “Phase field crystal modeling of lithium batteries”, Interdisciplinary Centre for Advanced Materials Simulation, Ruhr-University Bochum, Germany, 2017

CONFERENCES

[16] “Intercalation induced mechanical failure of olivine compounds”, 2018 MRS Fall Meeting and Exhibit, Oral presentation, Boston, MA, 2018

[15] “Combining the crystallographic texture of an electrode with Li-composition field”, Aerospace Engineering and Mechanics Symposium, University of Minnesota, MN, 2018

[14] “Modeling Phase Transition in Battery Electrodes Using the Coupled Cahn-Hilliard – Phase Field Crystal Methods”, 233rd ECS meeting Seattle, WA, 2018

[13] “Phase field crystal modeling of nanoscale electrodes”, American Physical Society (APS) March Meeting, Los Angeles, CA, 2018

[12] “Modeling Phase Transition in Lithium Batteries Using Multi-Scale Continuum Models”, Batteries Gordon Research Conference and Seminar, Ventura, CA, 2018, **Invited Discussion leader**

[11] “Phase Field Crystal Modeling of Coherent Interfaces in Lithium Batteries”, 231st Electrochemical Society meeting, New Orleans, LA, 2017

[10] “Phase Field Crystal Modeling Using Transformation Matrices – an Application to Lithium Battery Electrodes”, MRS Fall Meetings and Exhibits, Boston, MA, 2017

[9] “Phase-field Modeling of Material Microstructures”, Multiscale Theory and Computation Conference, University of Minnesota, MN, 2017

[8] “Stability of laminate patterns in ferroelectrics” (poster), From Grain Boundaries to Stochastic Homogenization: PIRE Workshop, Leipzig, 2015

[7] “Phase-field modelling of polarization patterns in ferroelectrics”, 9th European Solid Mechanics Conference, Madrid, 2015.

[6] “A conceptual design of a ferroelectric energy harvester”, MRS Spring Meetings and Exhibits, San Francisco, USA, 2015

[5] “A conceptual design of a ferroelectric energy harvester”, ASME SMASIS Spring Meetings and Exhibits, Utah, USA, 2014, **Best Student Paper Award**

[4] “Nano-actuator concepts”, Falling-Walls London-Lab, London, 2015
National Winner – represented UK in the finals held in Berlin, funded by AT Kearney

[3] “Working principle of a nano-actuator based on ferroelectric switching”, the proceedings of EC-COMAS conference on Smart Struct. Mat., Turin, 2013

[2] “Modelling and analysis of resonant beam micro-pressure sensor”, National Conference on MEMS and Smart Materials, Coimbatore, India, 2012, **Best Paper – ISSS Undergraduate Award**

[1] “Sound energy harvesting using macro-fibre composites”, 8th European Solid Mechanics Conference, Graz, Austria, 2012

SKILLS
 Programming languages: C++, Fortran, R, Mathematica, Matlab
 Software packages: ABAQUS, ANsys, FEAP, Paraview
 Statistical Analysis: Regression Analysis, Bayesian Data Analysis, Data Visualisation

TRAINING
 Successful grant writing strategies, Harvard University, 2018
 Data and Models: Regression Analytics, MIT Short Programs, 2018
 Imaging, Modeling, and Simulation of Li-Battery Microstructures, ECS, 2017
 Phase Field Models, Summer School at TU Munich, 2017
 R for Data Science (Grolemund and Wickham), Self-taught, 2016
 From Grain Boundaries to Stochastic Homogenization: PIRE Workshop, Leipzig, 2015

TEACHING EXPERIENCE

Mentor for undergraduates, Massachusetts Institute of Technology 2018
 Project: Spinodal decomposition under Cahn-Hilliard equation
 Mentored and advised two undergraduate students on developing a Cahn-Hilliard code

Teaching faculty, Oxford Royale Academy 2014 – 2015
 Designed course on “Mathematics as an Engineering tool” for prospective undergraduates
 Taught to a class of 25 students during summer terms

Tutor, Pembroke College, University of Oxford 2015
 Mechanics of Materials course, to undergraduate students Trinity term

Instructor, Department of Engineering, University of Oxford 2015
 Laboratory demonstration on bridge-design and construction to undergraduates

Training
 Kaufman Teaching Certificate, MIT teaching and learning laboratory, 2018
 Bringing Modeling and Simulation into My Classroom course, 2017 MRS Fall meeting
 Leadership and management workshop for scientists, MIT EECS, 2017

PROFESSIONAL ACTIVITIES

Ad hoc reviewer
 Physical Review E, B, Materials
 Modelling and Simulation in Materials Science and Engineering
 Smart Materials and Structures
 European Journal of Mechanics
 Materials Research Express

Service
 Coordinating a multi-PI project on chemo-mechanics of batteries at MIT
 Organized Postdoc seminars in the Department of Materials Science, MIT
 Congressional Visit Days, MIT Postdoc rep. for MIT Science Policy Initiative 2017
 Discussed science policy issues & research budgets with Mass. representatives in Congress

Professional memberships
 Electrochemical Society
 American Physical Society

Others
 Basketball player: University of Oxford (Varsity 2012 – 2014), English Basketball League (2012 – 2014), National Institute of Technology, India (2008 – 2012)

REFERENCES

W. Craig Carter

POSCO Professor
Dept. of Materials Science and Engineering
Massachusetts Institute of Technology
77 Mass. Ave, 13-4053, Cambridge, MA 02139
Phone: +1 (617) 253-6048
Email: ccarter@mit.edu

John E. Huber

Associate Professor
Department of Engineering Science
University of Oxford
Parks Road, Oxford, OX1 3PJ
Phone: +44 (1865) 283-478
Email: john.huber@eng.ox.ac.uk

Brian Sheldon

Professor
School of Engineering
Brown University
184 Hope St, Providence, RI 02912
Email: brian.sheldon@brown.edu

Richard D. James

Distinguished McKnight University Professor
Dept. of Aerospace Engineering and Mechanics
University of Minnesota
110 Union St, Minneapolis, MN 55455
Phone: +1 (612) 625-0706
Email: james@umn.edu

Yet-Ming Chiang

Kyocera Professor
Department of Materials Science and Engineering
Massachusetts Institute of Technology
77 Mass. Ave, 13-4086, Cambridge, MA 02139
Phone: +1 (617) 253-6471
Email: ychiang@mit.edu