

Ananya Renuka Balakrishna

77 Massachusetts Avenue, 13-4026

MIT, Cambridge MA 02139

ananyarb@mit.edu, ananyabalakrishna.com

RESEARCH INTERESTS	I develop mathematical models (phase-field, cohesive-zone) to investigate the link between material microstructures and properties in energy storage and functional materials.	
PROFESSIONAL APPOINTMENT	Massachusetts Institute of Technology , Cambridge, MA, USA Postdoctoral Fellow in Materials Science and Engineering Project: Combining Cahn-Hilliard and phase-field-crystal models for intercalation electrodes Advisors: W. Craig Carter, Yet-Ming Chiang	Nov. 2016 – present
EDUCATION	University of Oxford , Oxford, UK DPhil in Solid Mechanics and Materials Engineering Thesis: Phase field modeling of ferroelectrics Advisor: John E. Huber	2016
	National Institute of Technology Karnataka , Surathkal, India B. Tech in Mechanical Engineering Best Student Award (academic and extra-curricular recognition)	2012
SKILLS & TRAINING	<p>Skills</p> <ul style="list-style-type: none">• Programming languages: R, C++, Fortran, Mathematica, Matlab• Software packages: ABAQUS, ANsys, FEAP, Paraview• Statistical Analysis: Regression Analysis, Clustering Analysis, Bayesian Data Analysis, Data Visualisation <p>Training</p> <ul style="list-style-type: none">• Machine Learning, Professor John Paisley, edX Columbia University, expected Sept 2018• Data and Models: Regression Analytics, MIT Short Programs, 2018• Phase Field Models, Summer School at TU Munich, 2017• Sentiment analysis, Text Mining with R (Silge and Robinson), Self-taught, 2017• R for Data Science (Grolemund and Wickham), Self-taught, 2016• From Grain Boundaries to Stochastic Homogenization: PIRE Workshop, Leipzig, 2015	
AWARDS & HONORS	<p>Data Incubator Fellowship (Finalist), 2018</p> <p>Lindemann Postdoctoral Fellowship (3 awarded across the UK), 2016</p> <p>Brasenose Senior Hulme Scholarship (PhD academic excellence), 2015</p> <p>Felix Graduate Scholarship (5 awarded across India), 2012</p> <p>Cambridge International & Commonwealth Trust (Honorary scholar), 2012</p> <p>DAAD-WISE Fellowship (Undergraduate Research), 2011</p> <p>Falling-Walls London-Lab Winner, 2014</p>	

GRANTS

British Federation of Women Graduates Award, 2015 (£2000)
(Awarded among 377 applicants all over UK to further PhD research)

Brasenose College annual grant, University of Oxford (£1500)

Graduate student travel grant, Administered by PIRE and NSF (€500)

Santander academic travel grant, Santander Bank (£500)

PUBLICATIONS

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 [cond-mat.mtrl-sci]

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

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

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

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

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

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

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

Renuka Balakrishna A and Huber JE. 2014. Design optimisation of a ferroelectric nano-actuator using phase field modeling. *Proceedings of the MRS conference, San Francisco, USA*. 10.1557/opl.2014.545

Manuscripts in preparation

Bucci G, **Renuka Balakrishna A**, Talamini B, Chiang Y-M, and Carter WC. 2018. Mechanical instability of electrode/electrolyte interfaces in solid-state batteries. Draft available

Renuka Balakrishna A, Henriksen C, Ravnsbaek DB, Tang M, Carter WC, Chiang Y-M. Intercalation induced mechanical failure of olivine compounds.

PERSONAL PROJECTS

(1) I analyzed data from the Economic Research Service ($N > 5,000$) to evaluate whether food pricing in supermarkets influences our choice of choosing a healthy (fruit/vegetable) or an unhealthy (crisp / chocolate) snack. I mapped out a cost-impact plot to inform users of affordable healthy substitutes for an unhealthy snack. This project was selected for the Data Incubator Fellowship 2018.

(2) I am analyzing battery survey data from Tesla vehicle users ($N > 1,000$) to evaluate whether frequencies of supercharging and driving the car with almost-empty battery affects capacity fade. I am testing whether capacity fade is accelerated from frequent daily usage with low charge levels.

CONFERENCES
& INVITED TALKS

“Intercalation induced mechanical failure of olivine compounds”, MRS Fall Meeting, Abstract submitted, Boston, MA, 2018 *Upcoming*

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

“Modeling Phase Transition in Lithium Batteries Using Multi-Scale Continuum Models”, Batteries Gordon Research Conference and Seminar, Ventura, CA, 2018

Invited Discussion leader

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

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

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

“Phase field crystal modeling of lithium batteries”, Interdisciplinary Centre for Advanced Materials Simulation, Ruhr-University Bochum, Germany, 2017 (Invited talk)

“Phase field modeling of microstructural evolution”, Aerospace Engineering and Mechanics Research Seminar, University of Minnesota, MN, 2017 (Invited talk)

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

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

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

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

“A conceptual design of a ferroelectric energy harvester”, ASME SMASIS Spring Meetings and Exhibits, Utah, USA, 2014

Best Student Paper Award

“Nano-actuator concepts”, Falling-Walls London-Lab, London, 2015

National Winner – represented UK in the finals held in Berlin, funded by AT Kearney

“Working principle of a nano-actuator based on ferroelectric switching”, the proceedings of ECCOMAS conference on Smart Struct. Mat., Turin, 2013

“Modelling and analysis of resonant beam micro-pressure sensor”, National Conference on MEMS and Smart Materials, Coimbatore, India, 2012

Best Paper – ISSS Undergraduate Award

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

PROFESSIONAL
ACTIVITIES

Teaching

- Teaching Faculty, Oxford Royale Academy
Designed and taught “Mathematics as an Engineering tool” to undergraduates in 2014, 2015
- Tutor, Pembroke College, University of Oxford
Mechanics of Materials course, to undergraduate students Trinity term, 2015
- UROP Mentor, Massachusetts Institute of Technology
Project: Spinodal decomposition under Cahn-Hilliard equation, 2018
- Lab Instructor, Department of Engineering, University of Oxford
Laboratory demonstration on bridge-design and construction to undergraduates, 2015
- Additional 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

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, 2017 – 2018
- Organized Postdoc seminars in the Department of Materials Science, MIT, Fall 2017
- MIT Postdoc rep. for Congressional Visit Days, 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

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

John E. Huber

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

Yet-Ming Chiang

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

Ingo Muench

Assistant Professor of Engineering Science
Karlsruhe Institute of Technology
Institute for Structural Analysis, Karlsruhe, 76131
Phone: +49 (721)-608-422-89
Email: ingo.muench@kit.edu