

# CURRICULUM VITAE

## **Dr. MIKKO P. HAATAJA**

Assistant Professor

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12/20/2008

Nationality: Finnish

Date of birth: 22.07.1971

Place of birth: Porvoo, Finland

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## EDUCATION

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| 09/1996 – 07/2001 | <u>PhD</u> in Theoretical Condensed Matter Physics,<br>Department of Physics, McGill University,<br>Montreal, Canada<br>Thesis title: “Model of elastic effects and<br>dislocations in strained heteroepitaxial films”<br>Thesis supervisor: Prof. Martin Grant |
| 08/1991 – 09/1995 | <u>MSc</u> in Electrical Engineering, Tampere University<br>of Technology, Tampere, Finland   |

## CURRENT POSITION

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| 9/1/2004 – present | Assistant Professor of Mechanical and Aerospace<br>Engineering, Princeton University, Princeton, NJ<br>08544 |
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## PREVIOUS POSITIONS

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| 07/2003 – 9/2004  | Post-doctoral researcher at Department of<br>Materials Science and Engineering, McMaster<br>University, Hamilton, Ontario, Canada |
| 06/2001 – 07/2003 | Post-doctoral researcher at Department of<br>Mechanical and Aerospace Engineering, Princeton<br>University, Princeton, NJ, USA    |
| 09/1995 – 08/1996 | Junior researcher at Research Institute for<br>Theoretical Physics, University of Helsinki,<br>Helsinki, Finland                  |

## RESEARCH INTERESTS

- Materials physics – microstructure and morphology evolution during solidification, thin film deposition, and phase transformations; physics and mechanics of biomaterials
- Mechanics of materials – elastic effects and dislocations in thin film growth and phase transformations

- Theory and simulation – large scale phase-field modeling of complex free-boundary problems in thin film growth, solidification, and solid-solid phase transformations
- Biophysics and mechanics – physical biology of the cell; evolving microstructures in materials science and biology

### INVITED TALKS

- Lecture at the Workshop on thermodynamic and structural properties of materials, Avignon, France (9/11/2001).
- Department of Physics Seminar, Universite Joseph-Fourier, Grenoble, France (9/17/2001).
- Department of Physics Seminar, Dalhousie University, Halifax, Canada (10/4/2001).
- Lecture at NATO summer school on thermodynamics and plasticity, Frejus, France (9/9/2002).
- Brockhouse Institute for Materials Research Colloquium, McMaster University, Hamilton, Ontario, Canada (3/17/2003).
- Lecture at SIAM Meeting, Snowbird, Utah, USA (5/27/2003).
- Lecture at TMS Meeting, Charlotte, North Carolina, USA (3/16/2004).
- Lectures (3hrs) at Canadian Network of Computational Materials Science Summer School on Computational Modeling of Microstructure Evolution, Hamilton, Ontario, Canada (6/6/05-6/10/05).
- CECAM meeting "Multiscale modeling in soft matter systems", Lyon, France (10/15/2006).
- CMSN meeting, New York, NY (2/15/2007).
- PACM Colloquium, Princeton University (4/23/2007)
- Univ. Delaware Colloquium (4/27/2007)
- Department of Physics Seminar, Dalhousie University, Halifax, Canada (10/31/2007)
- Mechanical Engineering Department Seminar, City College of New York (11/8/2007)
- Third Asian-Pacific Congress on Computational Mechanics, Kyoto, Japan (12/3/2007)
- TMS Annual Meeting, New Orleans, Louisiana, USA (3/11/2008)
- Department of Mathematics Seminar, NJIT (4/18/2008)
- Department of Materials Science and Engineering Colloquium, Northwestern University (4/29/2008)
- SIAM Meeting on Mathematical Aspects of Materials Science, Philadelphia, PA (5/14/2008)
- MagDot Workshop on magnetic thin films, Napa, CA (8/19/2008)
- Wayne State University Physics Seminar, Detroit MI (10/28/2008)
- Rutgers University Materials Science Department seminar, New Brunswick NJ (11/11/2008)

### CONTRIBUTED TALKS AND PRESENTATIONS

- MRS Fall Meeting; oral presentation 12/5/2008 (Boston, MA). "Dislocation Pinning/Depinning by Impurities and Obstacles: A Level Set Simulation Study" by Z. Chen, K. T. Chu, J. R. Rickman, D. J. Srolovitz, and M. Haataja.
- MRS Fall Meeting; oral presentation 12/5/2008 (Boston, MA). "Low-angle Grain Boundary Migration and Mobility in the Presence of

- Extrinsic Dislocations” by A. Lim, A. Rollett, M. Haataja, and D. J. Srolovitz.
- TMS Meeting; oral presentation 3/10/2008 (New Orleans, LA). “Dislocation pinning by solutes and obstacles: A level-set dislocation dynamics study” by Z. Chen, K. T. Chu, J. R. Rickman, D. J. Srolovitz, and M. Haataja.
  - TMS Meeting; **invited** oral presentation 3/12/2008 (New Orleans, LA). “Morphology evolution in polycrystalline materials” by R. Krishnamurthy and M. Haataja.
  - 48th International Conference on the Bioscience of Lipids; poster presentation 8/31/2007 (Turku, Finland). “Micellization of surfactants: A molecular dynamics study” by M. Sammalkorpi, M. Karttunen, and M. Haataja.
  - American Physical Society 2007 March Meeting; oral presentation 3/9/2007 (Denver, CO). “Non-equilibrium dynamics of heterogeneous lipid membranes” by J. Fan, M. Sammalkorpi, and M. Haataja.
  - American Physical Society 2007 March Meeting; oral presentation 3/7/2007 (Denver, CO). “Phase-field model for recrystallization kinetics” by S. Sreekala and M. Haataja.
  - American Physical Society 2007 March Meeting; oral presentation 3/5/2007 (Denver, CO). “Self-assembly of ionic detergents: A molecular dynamics study of sodium dodecylsulphate micellization” by M. Sammalkorpi, M. Karttunen, and M. Haataja.
  - American Physical Society 2007 March Meeting; poster presentation 3/7/2007 (Denver, CO). “Orientational ordering of surfactants and hydrocarbons on graphite” by M. Sammalkorpi, A. Z. Panagiotopoulos, and M. Haataja.
  - TMS Annual Meeting 2007; oral presentation 3/1/2007 (Orlando, FL). “Coupled phase-field and coarse-grained dislocation method for recrystallization kinetics” by S. Sreekala and M. Haataja.
  - American Physical Society 2006 March Meeting; oral presentation 3/5/2006 (Baltimore, MD). “Phase-field Crystal model with elastic interactions” by Peter Stefanovic, M. Haataja, and N. Provatas.
  - MRS Fall Meeting 2005; poster presentation 12/1/2005 (Boston, MA). “Modeling elastic and plastic deformation of nanostructured materials” by Peter Stefanovic, M. Haataja, and N. Provatas.
  - TMS Annual Meeting 2005; oral presentation 2/15/2005 (San Francisco, CA). “Dislocation-Induced Crossover Scaling During Spinodal Decomposition” by M. Haataja, J. Mahon, N. Provatas, and F. Leonard.
  - MRS Spring Meeting 2005; oral presentation 3/1/2005 (San Francisco, CA). “Dislocation-Induced Crossover Scaling During Spinodal Decomposition” by M. Haataja, J. Mahon, N. Provatas, and F. Leonard.
  - MRS Fall Meeting 2004; poster presentation 12/1/2004 (Boston, MA). “Apparent hysteresis in a driven system with self-organized drag” by M. Haataja, D. J. Srolovitz, and Y. Kevrekidis.
  - Annual Meeting of the Electrochemical Society 2003; oral presentation 10/25/2002 (Salt Lake City, UT). “Instabilities and additive-induced stabilization during electrodeposition” by M. Haataja, D. J. Srolovitz, and A. Bocarsly.

## SCHOLARSHIPS AND HONORS

- 1996 – 2000 PhD scholarship from the Academy of Finland

- 2001 PhD from McGill University with distinction (Dean's honor list)
- 2006 Princeton Univ. E-Council "Excellence in Teaching" Award
- 2007 Princeton Univ. E-Council "Excellence in Teaching" Award
- 2007 Howard B. Wentz, Jr. SEAS Junior Faculty Award (Princeton Univ.)

#### GRANTS AND AWARDS—ACTIVE

(Total amount to date: \$519,000)

- 8/1/2005-7/31/2010 NSF Faculty Early Career Development (CAREER) Award (\$400,000)
- 1/1/2005-31/12/2007 AFOSR Grant (w/Dr. J. M. Rickman, Lehigh University; \$160,000)
- 11/1/2006-8/31/2008 PCCM/Princeton Univ. MRSEC Seed (w/Prof. Athanassios Panagiotopoulos, ChemE Dept.; \$119,000)
- 9/1/2008-8/31/2014 PCCM/Princeton Univ. MRSEC IRG (multiple PIs, total amount for PI \$300,000)
- 9/1/2008-8/31/2009 PCCM/Princeton Univ. MRSEC Seed (w/Prof. Wole Soboyejo, MAE Dept., and Prof. Jean Schwarzbauer, MolBio Dept.; \$80,000)

#### GRANTS AND AWARDS—PENDING

- DOE (w/Profs. W. Soboyejo and E. Choueiri, MAE Dept.; three year grant for \$1,200,000)
- DOE dislocation dynamics (co-PI, three year grant for \$300,000)
- NSF dislocation dynamics (co-PI, three year grant for \$300,000)
- NSF lipid vesicles (co-PI, three year grant for \$240,000)
- NIH lipid vesicles (co-PI, two year grant for \$175,000)

#### SUPERVISED STUDENTS AND POST-DOCS

6/1/2002 – 8/15/2002	Mr. Adrian Mullings (Princeton University undergraduate student); supervised his summer research project on additive effects in electrodeposition
9/1/2005 – present	Ms. Jun Fan (PhD student at Princeton Univ.)
9/1/2005 – present	Mr. Zi Chen (PhD student at Princeton Univ.)
9/1/2005 – present	Ms. Adele Lim (PhD student at Princeton Univ.)
11/1/2005 – 10/30/2006	Dr. Subbulakshmi Sreekala (post-doc at PU)
2/1/2006 – present	Dr. Maria Sammalkorpi (post-doc at PU)
6/3/2006 – 8/13/2006	Mr. Jordan Vincent (REU student)
10/1/2006 – 5/31/2006	Mr. Zach McKinney (MAE Senior; IW Project)
6/11/2007 – 8/10/2006	Mr. Jaime Osorio (REU student)
6/1/2008 – present	Mr. Srevatsan Muralidharan (PhD student at PU)
8/15/2008 – present	Dr. Lisa Manning (post-doc at PU)

9/1/2008 – present      Mr. Fadi Abdeljawad (PhD student at PU)

### CO-ADVISED STUDENTS AND POST-DOCS

- 10/1/2003 – 4/30/2004   Ms. Jennifer Mahon (McMaster University undergraduate student); co-supervised her final year thesis research project
- 9/1/2005 – 8/31/2007    Dr. Kevin T. Chu (co-advisor Dr. David J. Srolovitz)
- 12/1/2005 – 12/1/2006   Dr. Ji-Hee Kim (co-advisor Dr. David J. Srolovitz)
- 12/1/2007 – present     Dr. Carmel Majidi (co-advisor Dr. David J. Srolovitz)

### TEACHING EXPERIENCE

- Lecturer, MAE-305 ``Mathematics in Engineering”, School of Engineering and Applied Science, Princeton University (Fall 2005).
- Lecturer, MSE-502 ``Thermodynamics and Kinetics”, Princeton University (Spring 2006; Spring 2007; Spring 2008).
- Lecturer, MAE-323 ``Advanced Solid Mechanics and Structural Design”, Mechanical and Aerospace Engineering Department, Princeton University (Fall 2004).
- Lecturer, MAE-223 ``Modern Solid Mechanics”, Mechanical and Aerospace Engineering Department, Princeton University (Fall 2006, Fall 2007, Fall 2008).

### SYNERGISTIC ACTIVITIES

- Referee for Physical Review Letters, Physical Review B, and International Journal of Solids and Structures
- Referee and panel reviewer for NSF
- Reviewer for DoD
- A key contributor to the 2048 processor IBM BlueGene Supercomputer "Orangena"
- Affiliated Faculty, the Princeton Institute for the Science and Technology of Materials (PRISM)
- Affiliated Faculty, the Program in Applied and Computational Mathematics (PACM) at Princeton University

### SERVICE TO THE DEPARTMENT & UNIVERSITY

- Member, Committee on the Course of Study (9/1/2006-present)
- Member, "Transformative Engineering and the Life Sciences" Search Committee, SEAS (9/1/2005-5/31/2006)
- Graduate Committee Member, MAE Department (9/1/2005-present)
- SEAS Freshman Advisor (Sept. 2005-May 2006)
- MAE Upperclass Advisor (Sept. 2004-present)

- PRISM Undergraduate Committee Member (9/1/2005-present)
- PRISM Graduate Seminar Series Coordinator (6/31/2005-present)
- Examiner in math and/or materials science in general exams for several current 2<sup>nd</sup> and 3<sup>rd</sup> year graduate students
- PhD Thesis reader for Mr. Hao Zhang (Princeton Univ.), Mr. Yifang Cao (Princeton Univ.), Mr. Chun-Wei Pao (Princeton University), and Mr. Wei Zhao (Helsinki University of Technology, Finland)

### SERVICE TO THE COMMUNITY

- Principal Editor, Journal of Materials Research (11/14/2007-present)
- Member, Chemistry and Physics of Materials Committee, TMS (11/12/2007-present)
- Organizer, Computational Materials Science Network (CMSN) Meeting, Princeton 9/22-9/23/2008

### PUBLICATIONS

#### ARTICLES IN REFEREED JOURNALS:

1. M. Haataja, J. A. Nieminen, and T. Ala-Nissila, "Molecular ordering of precursor films during spreading of tiny liquid droplets", Phys. Rev. E **52**, R2165 (1995).
2. M. Haataja, J. A. Nieminen, and T. Ala-Nissila, "Dynamics of Spreading of Chainlike Molecules with Asymmetric Surface Interactions", Phys. Rev. E **53**, 5111 (1996).
3. N. Provatas, M. Haataja, E. Seppälä, S. Majaniemi, J. Åström, M. Alava, and T. Ala-Nissila, "Growth, Percolation and Correlations in Disordered Fibre Networks", J. Stat. Phys. **87**, 385 (1997).
4. M. Kuittu, M. Haataja, N. Provatas, and T. Ala-Nissila, "Dynamics of driven interfaces near isotropic percolation transition", Phys. Rev. E **58**, 1514 (1998).
5. M. Kuittu, M. Haataja, and T. Ala-Nissila, "Dynamics of driven interfaces in algebraically correlated media", Phys. Rev. E **59**, 2677 (1999).
6. M. Karttunen, M. Haataja, K. R. Elder, and M. Grant, "Defects, order and hysteresis in driven charge-density waves", Phys. Rev. Lett. **83**, 3518 (1999).
7. N. Provatas, M. Haataja, J. Asikainen, S. Majaniemi, M. Alava, and T. Ala-Nissila, "Fibre deposition models in two and three spatial dimensions", Colloids and Surfaces A **165**, 209 (2000).
8. M. Haataja, J. Müller, A. D. Rutenberg, and M. Grant, "Dynamics of dislocations and surface instabilities in misfitting heteroepitaxial films", Phys. Rev. B **65**, 035401 (2002).

9. M. Haataja, J. Müller, A. D. Rutenberg, and M. Grant, “Dislocations and morphological instabilities: Continuum modeling of misfitting heteroepitaxial films”, *Phys. Rev. B* **65**, 165414 (2002).
10. K. R. Elder, M. Katakowski, M. Haataja, and M. Grant, “Modeling Elasticity in Crystal Growth”, *Phys. Rev. Lett.* **88**, 245701 (2002).
11. M. Haataja and D. J. Srolovitz, “Morphological Stability and Additive-Induced Stabilization in Electrodeposition”, *Phys. Rev. Lett.* **89**, 215509 (2002).
12. M. Haataja, D. J. Srolovitz, and A. B. Bocarsly, “Morphological Stability during Electrodeposition I: Steady-state and stability analysis”, *J. Electrochem. Soc.* **150**, C699 (2003).
13. M. Haataja, D. J. Srolovitz, and A. B. Bocarsly, “Morphological Stability during Electrodeposition II: Additive effects”, *J. Electrochem. Soc.* **150**, C708 (2003).
14. N. Provatas, Q. Wang, M. Haataja, and M. Grant, “Seaweed to Dendrite Transition in Directional Solidification”, *Phys. Rev. Lett.* **91**, 155502 (2003).
15. A. E. Lobkovsky, A. Karma, M. I. Mendeleev, M. Haataja, and D. J. Srolovitz, “Grain shape, grain boundary mobility, and the Herring relation”, *Acta Materialia* **52**, 285 (2004).
16. M. Haataja and F. Léonard, “Spinodal decomposition in the presence of mobile dislocations”, *Phys. Rev. B* **69**, 081201 (R) (2004).
17. M. Haataja, D. J. Srolovitz, and Y. G. Kevrekidis, “Apparent hysteresis in a driven system with self-organized drag”, *Phys. Rev. Lett.* **92**, 160603 (2004).
18. M. Greenwood, M. Haataja, and N. Provatas, “Crossover Scaling of Wavelength Selection in Directional Solidification of Binary Alloys”, *Phys. Rev. Lett.* **93**, 246101 (2004).
19. F. Léonard and M. Haataja, “Alloy destabilization by dislocations”, *Appl. Phys. Lett.* **86**, 181909 (2005).
20. M. Haataja, J. Mahon, N. Provatas, and F. Léonard, “Scaling of domain size during spinodal decomposition: Dislocation discreteness and mobility effects”, *Appl. Phys. Lett.* **87**, 251901 (2005).
21. P. Stefanovic, M. Haataja, and N. Provatas, “Phase-field Crystals with Elastic Interactions”, *Phys. Rev. Lett.* **96**, 225504 (2006).
22. J. Fan, M. Greenwood, M. Haataja, and N. Provatas, “Phase-field simulations of rapid solidification of binary alloys”, *Phys. Rev. E* **74**, 031602 (2006).

23. S. Sreekala and M. Haataja, “Recrystallization kinetics: A coupled coarse-grained dislocation density and phase-field approach”, *Phys. Rev. B* **76**, 094109 (2007).
24. M. Sammalkorpi, M. Karttunen, and M. Haataja, “Structural properties of ionic micellar aggregates: A large scale molecular dynamics study of sodium dodecyl sulphate”, *J. Phys. Chem. B* **111**, 11722 (2007).
25. M. Sammalkorpi, A. Z. Panagiotopoulos, and M. Haataja, “Structure and Dynamics of Surfactant and Hydrocarbon Aggregates on Graphite: A Molecular Dynamics Simulation Study”, *J. Phys. Chem. B* **112**, 2915 (2008).
26. J. Fan, M. Sammalkorpi, and M. Haataja, “Domain Formation in the Plasma Membrane: Roles of Cellular Lipid Transport and Membrane Proteins”, *Phys. Rev. Lett.* **100**, 178102 (2008).
27. J. M. Rickman, M. Haataja, and R. LeSar, “Impact of Obstacles on Dislocation Patterning”, *Phys. Rev. B* **77**, 174501 (2008).
28. M. Sammalkorpi, A. Z. Panagiotopoulos, and M. Haataja, “Structure and Dynamics of Surfactant and Hydrocarbon Aggregates on Defective Graphite: A Molecular Dynamics Simulation Study”, *J. Phys. Chem. B* **112**, 12954 (2008).
29. D. Van Valen, M. Haataja, and R. Phillips, “Biochemistry on a leash: The roles of tether length and geometry in signal integration proteins”, accepted for publication in the *Biophysical Journal* (2008).
30. J. Meng *et al.*, “LHRH-Functionalized Superparamagnetic Iron Oxide Nanoparticles for Breast Cancer Targeting and Contrast Enhancement in MRI”, accepted for publication in *Mat. Sci. Eng. C* (2008).
31. M. Sammalkorpi, M. Karttunen, and M. Haataja, “Micelle Fission via Surface Instability and Formation of an Interdigitating Stalk”, accepted for publication in *JACS* (2008).

ARTICLES IN CONFERENCE PROCEEDINGS WITH REFEREE PRACTICE:

32. N. Provatas, M. Haataja, E. Seppälä, S. Majaniemi, M. Alava, and T. Ala-Nissila, “Structural properties of disordered fibre networks”, *Physica A* **239**, 304 (1997).
33. M. Haataja, D. J. Srolovitz, and A. B. Bocarsly, “Models for roughness evolution during electrodeposition of magnetic metals with and without additives”, pp. 386-398 in *Magnetic Materials, Processes and Devices VI and Electrodeposition of Alloys* (S. Krongelb *et al.* (eds), The Electrochemical Society, 2003).
34. M. Haataja and M. Grant, “Surface instabilities and misfit dislocations in annealed heteroepitaxial films”, pp. 301-310 in

MANUSCRIPTS UNDER REVIEW:

35. A. Jusufi, A.-P. Hynninen, M. Haataja, and A. Panagiotopoulos, “Electrostatic screening and charge correlation effects in micellization of ionic surfactants” (submitted to JPCB).
36. M. Karttunen, M. Haataja, M. Saily, I. Vattulainen, and J. Holopainen, “Flower power: Lipid domain morphologies in Langmuir monolayer binary systems” (submitted to Langmuir).
37. C. Majidi, D. J. Srolovitz, and M. Haataja, “Theory for the Spontaneous bending of piezoelectric nanoribbons” (submitted to Physical Review Letters).

MANUSCRIPTS IN PREPARATION:

38. R. Krishnamurthy and M. Haataja, “Morphological evolution in polycrystalline films” (revised version to be resubmitted to J. Appl. Phys.).
39. M. Sammalkorpi, M. Karttunen, and M. Haataja, “Effect of excess salt on micelle formation kinetics”.
40. Z. Chen, K. T. Chu, J. R. Rickman, D. J. Srolovitz, and M. Haataja, “Solutal effects on dislocation motion: A Level-set simulation study”.
41. J. Fan, M. Sammalkorpi, and M. Haataja, “Formation of compositional domains in plasma membranes: Effects of lipid transport and membrane proteins”.
42. C. Majidi, D. J. Srolovitz, and M. Haataja, “Theory for the Spontaneous Bending of Piezoelectric Nanoribbons: Coupling Between Mechanical Properties, Spontaneous Polarization, and Space Charge”.
43. P. Stefanovic, M. Haataja, and N. Provatas, “Phase-field crystal study of hardening in nanocrystalline metals and alloys”.