

# DR. MICHAEL PHILIP SHORT

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## OBJECTIVE

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A faculty position in the area of nuclear materials science that allows me the freedom and flexibility to pursue original, innovative research projects and mentor bright, self-motivated students

## ACTIVE AREAS OF RESEARCH

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- Corrosion product deposition resistance
- Atomistic studies of deposition and deposition prevention
- Multiphysics, multiscale, fully coupled modeling & simulation
- Composite alloy development for current and future nuclear reactors
- Material & microstructure design for new alloys
- Experimental material design for extreme environments

## SUMMARY OF QUALIFICATIONS

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- 10 years research experience in nuclear materials science and engineering
- Especially skilled at experimental design and the use of relevant analytical methods
  - Comfortable programming, modeling, simulating, and conducting multi-scale experiments

## WORK EXPERIENCE

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**Consortium for Advanced Simulation of Light Water Reactors (CASL)** 2010 to Present  
**Positions: Postdoctoral Lecturer, Research Scientist**

- Developing a validated, predictive model (MAMBA-BDM) for tracking boron and lithium deposition in fuel CRUD in pressurized water reactors (PWRs)
- **Independently researching new options to prevent CRUD deposition (IP on file with USPTO (provisional application #61/600,128), proposals submitted to EPRI, CASL)**
- **Proposed & awarded contract w/ EPRI to investigate novel CRUD-resistant materials**

**MIT Nuclear Materials Lab**, Cambridge, MA (<http://web.mit.edu/uhliglab/>) 2001 to Present  
**Positions: UROP, Research Assistant, Postdoctoral Lecturer, Research Scientist**

- Researching corrosion in lead-bismuth eutectic (LBE) and supercritical CO<sub>2</sub>
- Developed a composite to make LBE-cooled reactors more feasible and economical
- Researched rates and mechanisms of Pd attack on SiC and ZrC with applications to the Pebble Bed Modular Reactor
- Repaired a non-functioning scanning electron microscope (SEM), and currently running the department's radiation-approved SEM facility (past 5 years)
- Analyzed the fitness-for-service of the MIT Alcator main power rotor, leading to both my master's thesis *and* a reversal of the decision not to continue operation (see below for the paper concerning this work)
- Supervised nine UROP students over the course of four years

**Prof. Tetsuo Shoji's Fracture Research Institute, Tohoku University**, Sendai, Japan 2003  
**Position: Summer Research Intern**

- Researched oxide formation in the Onagawa nuclear plant using SEM, EDX and Raman spectroscopy, leading to a conference paper

## ENTREPRENEURIAL EXPERIENCE

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**Ergopedia**, Cambridge, MA (<http://www.ergopedia.com/>) 2006 to Present

**Positions: Author, Electrical Engineer, Web Developer, Technical Director**

- Achieved over \$800,000 revenue in our first full year of sales (2010)
- Co-author of *A Natural Approach to Chemistry* lab manual and teacher's guide
  - Contributor to textbook, solutions manual, laboratory investigations, teacher's guide
- Co-developed the LabMaster™, a student-friendly data collection and visualization station that lets students learn chemistry by intuition and experimentation
  - Wrote all the software, co-designed the hardware
- Creating an online author tool for developing coherent, interactive curricula for math, sciences and engineering for all age groups and skill levels, incorporating differentiated instruction, state-based educational standard correlation, secure automatic assessment, and dynamically generated and updated textbook content

**LEDStorm LLC**, North Andover, MA (<http://www.ledstorm.com/>) 2007 to 2010

**Positions: Co-Founder, Co-Manager, CTO**

- Achieved \$187,000 revenue in our first full year of sales (2009)
- Developed two lines of LED fixtures (18 fixtures for cinema and public lighting) without any outside funding
- Fixtures I developed are the premiere lighting instruments on major motion pictures and popular network television shows, such as *Dexter*, *True Blood* and *Survivor: Nicaragua*

## CONSULTING EXPERIENCE

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- A123 Systems, Hologic, Inc., Interlace Medical, Inc., Xtalic Corp., Transatomic Power
  - Performed metallurgical, optical, microhardness and SEM analysis
  - Recommended changes in product design based on material analysis
  - Designing & coordinating experimental program for new reactor concept

## EDUCATION

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**Ph.D., Nuclear Science & Engineering**, MIT, Cambridge, MA August 2010

“A Functionally Graded Composite for Service in Advanced LBE-Cooled Systems”

Advisor: Ron Ballinger, Thesis Readers: Hannu Hänninen, Bilge Yildiz

Final GPA: 4.7/5.0

**M.S., Materials Science & Engineering**, MIT, Cambridge, MA July 2010

“The Effect of Microstructure on the Fatigue and Fracture Properties of Vintage Rotor Steels”

Advisors: Ron Ballinger, Sam Allen, Thesis Reader: Rui Vieira

**Dual B.S., Nuclear Engineering and Materials Science**, MIT, Cambridge, MA June 2005

Final GPA: 4.6/5.0 with a humanities concentration in Japanese

## TEACHING EXPERIENCE

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**22.033: Nuclear Systems Design Project**, MIT, Cambridge, MA 2011-2

- Led 17 students in designing a non-LWR reactor for producing hydrogen and biofuels to maximize output and profit
  - Selected as finalists in the 2012 ANS Student Design Competition
- Directed 13 students in designing a test reactor for the FHR salt-cooled reactor concept
  - Submitted two ANS summaries, one ICAPP paper based on course results
- Instructor Evaluation: 6.5/7.0 (2011-2) Course Overall Evaluation: 6.0/7.0 (2011-2)

## RELEVANT SKILLS

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**Analysis Techniques:** SEM with EDX, FIB, TEM, XRD, optical microscopy, Raman spectroscopy, macro micro & nano hardness testing, XPS; some experience with AFM, SIMS, VSM

**Computers:** Fluent in Windows, Mac OS & Linux, Programming in C, HTML, PHP, SQL, Maple, Visual Basic; atomistic simulation, including VASP and Quantum Espresso (DFT), GULP, Moldy, MD; multiphysics FEM simulation experience (INL's MOOSE framework)

**Electronics:** Power electronics, embedded device design, firmware development, schematic development and board fabrication with an emphasis on rapid prototyping and scalability

## LANGUAGES

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**English:** Native language      **French, Spanish:** Novice Listening, Speaking, Reading and Writing

**Japanese, Hebrew:** Intermediate Listening, Speaking, Reading and Writing

**Vietnamese:** Novice Listening and Speaking, Intermediate Reading and Writing

## JOURNAL PUBLICATIONS

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M. P. Short, D. Hussey, B. K. Kendrick, T. Bessman, D. Gaston, J. Li, C. Permann, S. Yip. "Multiphysics Modeling of Porous CRUD Deposits in Nuclear Reactors." *J. Nucl. Mater.*, *Under Review* (2012).

M. P. Short. "Using Cheese to Teach Theoretical and Experimental Metallurgy." *Adv. Eng. Education*, *Under Review* (2012).

P. V. Kumar, M. P. Short, S. Yip, B. Yildiz, J. C. Grossman. "High surface reactivity and water adsorption on NiFe<sub>2</sub>O<sub>4</sub> (111) surfaces." *J. Phys. Chem. C*, *Under Review* (2012).

P. V. Kumar, M. P. Short, S. Yip, B. Yildiz, J. C. Grossman. "First-Principles Assessment of the Reactions of Boric Acid on NiO (001) and ZrO<sub>2</sub> (-111) Surfaces." *J. Phys. Chem. C*, **116**:10113-10119 (2012).

M. P. Short, R. G. Ballinger, H. Hänninen. "Corrosion resistance of alloys F91 and Fe-12Cr-2Si in lead-bismuth eutectic up to 715C." *Accepted (DOI 10.1016/j.jnucmat.2012.11.010)*, *J. Nucl. Mater.* (2012).

M. P. Short, R. G. Ballinger. "A Functionally Graded Composite for Service in High-Temperature Lead- and Lead-Bismuth-Cooled Nuclear Reactors - I: Design." *Nucl. Tech.*, **177**(3):366-381 (2012).

J. Deshon, D. Hussey, B. Kendrick, J. McGurk, J. Secker, M. P. Short. "Pressurized Water Reactor Fuel Crud and Corrosion Modeling." *J. Minerals, Metals & Mater. Soc. (JOM)*, **63**(8):68-76 (2011).

M. P. Short, S. Morton, S. E. Ferry, R. G. Ballinger. "Diffusional stability of ferritic-martensitic steel composite for service in advanced LBE cooled nuclear reactors." *Int. Heat Treat. Surf. Eng.*, **4**(2):74-80 (2010).

## CONFERENCE PAPERS, TALKS & REVIEWS

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2013 (Submitted) – R. R. Romatoski, S. Don, J. Richard, M. P. Short, L. W. Hu, C. Forsberg. "Fluoride Salt-Cooled High Temperature Test Reactor Core Design." ANS Summer 2013, Atlanta, GA, June 16-20.

2013 (Planned) – M. P. Short. "Simulations and Experiments Aimed at Understanding, Preventing, and Controlling CRUD in PWRs." **Invited Talk**, Hanyang University, Seoul, Korea, April 19.

2013 (Planned) – J. Richard, M. P. Short, S. Don, R. R. Romatoski, L. W. Hu, C. Forsberg. "Preliminary Design of a Prismatic Core Fluoride Salt-Cooled High Temperature Test Reactor (FHTR)". ICAPP 2013, April 14-18, Jeju Island, Korea.

2013 (Planned) – M. P. Short *et al.* "Coupling Effects Between Multiphysical Phenomena, Thermodynamics, and Length Scales in 3D Modeling of PWR CRUD Deposits." **Invited Talk**, TMS-2013, San Antonio, TX, March 4.

2012 – M. P. Short *et al.* "Linking Length Scales with CRUD in CASL, the DOE Energy Innovation Hub." **Invited Talk**, Multiscale Materials Modeling (MMM-2012), Biopolis, Singapore.

2012 – M. P. Short. "Multiphysics Modeling & Simulation of PWR Fuel CRUD (MAMBA-BDM)." NUTHOS-9, Kaohsiung, Taiwan.

2012 – Reviewer (1 paper), HTR (High Temperature Reactor Technology), Miraikan, Tokyo, Japan

2012 – M. P. Short. "Multiphysics Modeling of Real PWR Fuel CRUD Scrapes (MAMBA-BDM)." **Invited Seminar**, North Carolina State University, Raleigh, NC.

2011 – P. V. Kumar, M. P. Short, S. Yip, J. C. Grossman, B. Yildiz. "First-Principles Assessment of the Boric Acid Reaction Mechanisms on NiO (001) and ZrO<sub>2</sub> (-111) Surfaces. MRS Fall 2011 Meeting, Boston, MA.

2011 – M. P. Short. "Functionally Graded Composites for Service in High-Temperature Lead and Lead-Bismuth Cooled Systems / Multiscale Modeling of PWR Fuel CRUD." **Invited Seminar**, North Carolina State University MSE Friday Seminar, Raleigh, NC.

2011 – M. P. Short, R. G. Ballinger. "The Design of a Functionally Graded Composite for Service in High-Temperature LBE-Cooled Reactors." *Accepted*, 19<sup>th</sup> International Conference on Nuclear Engineering (ICONE-19), Makuhari, Chiba, Japan.

2010 – M. P. Short, S. E. Ferry, S. Morton, R. G. Ballinger. "A Functionally Graded Composite for Service in LBE Cooled Nuclear Reactors." 3<sup>rd</sup> Tokyo Tech MERCES forum, Ishigaki, Japan.

2010 – Reviewer (10 papers), IYNC (International Youth Nuclear Conference), Johannesburg, South Africa.

2009 – M. P. Short, S. E. Ferry, S. Morton, R. G. Ballinger. "A Functionally Graded Composite to Resist Corrosion in Lead and LBE Fast Reactors." 2<sup>nd</sup> Tokyo Tech MERCES forum, Okinawa, Japan.

2009 – M. P. Short, S. Morton, R. G. Ballinger. "Functionally Graded Composites for Service in Advanced Lead-Bismuth Reactors." MIT-CEA-X, École Polytechnique, Palaiseau, France.

2007 – M. P. Short, S. Morton, R. G. Ballinger. "Functionally Graded Composites for Service in Advanced Lead-Bismuth Reactors." TM-INES2 Conference at Tokyo Tech, Tokyo, Japan (*delivered in Japanese*).

2004 – A. Bushman, D. M. Carpenter, T. S. Ellis, S. P. Gallagher, M. D. Hershcovitch, M. C. Hine, E. D. Johnson, S. C. Kane, M. R. Presley, A. H. Roach, S. Shaikh, M. P. Short, and M. A. Stawicki. "The Martian Surface Reactor: An Advanced Nuclear Power Station for Manned Extraterrestrial Exploration." MIT Conference on Space Exploration, Cambridge, MA.

2004 – A. Kai, M. P. Short, Y. Terayama, T. Tatsuki, T. Watanabe, T. Shoji. "Characterization of Oxide Film on the Surface of SCC in PLR Pipe by Micro Raman Spectroscopy and its Implication to Crack Growth Characteristics at Onagawa Nuclear Power Plant." 12<sup>th</sup> International Conference on Nuclear Engineering (ICONE-12), Arlington, VA.

**AWARDS**

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- Outstanding Staff Award – *MIT NSE Awards Night, 2012*
- Best Poster – *1<sup>st</sup> annual MIT NSE Research Expo, MIT, Cambridge, MA, 2010*
- Best Nuclear Energy Presentation - *2<sup>nd</sup> Tokyo Tech MERCES Forum, Okinawa, Japan, 2009*
- Best Graduate Paper – *Bodycote 2009 Paper Prize Competition, Köln, Germany*

**OUTSIDE ACTIVITIES AND INTERESTS**

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Bladesmithing, technology for K-12 STEM education, silver & goldsmithing, cycling, learning languages, hiking, electronics design

**REFERENCES AVAILABLE UPON REQUEST**

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