Approved by the Regents
May 20, 2010

PROMOTION RECOMMENDATION
The University of Michigan
College of Engineering

Katsuyo S. Thornton, assistant professor of materials science and engineering, Department of Materials Science and Engineering, College of Engineering, is recommended for promotion to associate professor of materials science and engineering, with tenure, Department of Materials Science and Engineering, College of Engineering.

Academic Degrees:

Ph.D.	1997	University of Chicago, Astronomy and Astrophysics, Chicago, IL
M.S.	1993	University of Chicago, Astronomy and Astrophysics, Chicago, IL
B.S.	1991	Iowa State University, Physics, Ames, IA

Professional Record:

2004-present	Assistant Professor, Department of Materials Science and Engineering, University of Michigan
2001-2004	Research Assistant Professor, Department of Materials Science and Engineering, Northwestern University
2001	Visiting Lecturer, Department of Materials Science and Engineering, Massachusetts Institute of Technology
1999-2000	Visiting Scientist, Department of Materials Science and Engineering, Massachusetts Institute of Technology
1997-2001	Postdoctoral Fellow, Department of Materials Science and Engineering, Northwestern University

Summary of Evaluation:

Teaching: Professor Thornton's classroom teaching record is very good. She has contributed to education in terms of typical classroom experiences, K-12 outreach, and advising undergraduate, graduate, and post-doctoral researchers within her research group. Professor Thornton has demonstrated capability and competence with all formal courses she has taught, with student teaching evaluations in the range of 4.13-4.7, which are above average for the department as a whole.

She has taught the introductory materials science course, as well as one of the undergraduate elective courses. She has developed her own graduate course, "Modeling and Simulation in Materials Science and Engineering." In addition, she has worked with the Center for Research on Learning and Teaching on efficient modes of lecture transmission, communicating with students, and effective learning exercises. Professor Thornton has actively promoted the role of women in engineering and science.

She has made significant contributions to outreach involving schools and libraries. Additionally, she is very active in materials education in the Minerals, Metals, and Materials Society (TMS) and the Materials Research Society (MRS), particularly in the area of computation. She will be chair of the first committee in this area for the TMS.

Research: Professor Thornton came to the field of materials science and engineering after completing her doctorate in Astrophysics, doing theory and simulations of supernova explosions. She was introduced to the field of materials science and engineering by a colleague who sought her help to collaborate with a post-doctoral researcher on a problem involving a multicomponent material system. Researchers had

limited success solving this problem quantitatively and Professor Thornton, who had a very intensive mathematical background, appeared to have the right skills. Professor Thornton has since made an excellent transition into the field and has become an active member of the computational materials community.

Professor Thornton develops theoretical and computational descriptions of the microstuctural features of multi-component material systems. Much of her work is centered around the mathematically intensive area involving phase field models; this enables her to formally describe the dynamics of a diverse range of problems that include moving interfaces in materials undergoing microstructural evolution (e.g., coarsening phenomena, dendritic formation), phase segregation in lipid membranes, and dynamic processes in materials for batteries and fuel cells. Her paper on fuel cells is considered a "landmark" by one reviewer. Her research on the phenomena of coarsening and phase transitions is widely recognized and highly regarded. She is considered to be "one of the pioneers in modeling microstructure evolution in energy materials."

Professor Thornton has developed a very strong sponsored research program with nine active research projects, which she has achieved through the formation of extensive collaborations. Professor Thornton has also published in a very large number of internationally respected journals, covering a wide range of topics, with strong overall impact factors. Her h-factor is 11, which is comparable to that of the very best researchers at her level of experience.

Recent and Significant Publications:

H.-C. Yu, X. Li, and K. Thornton, "Kirkendall-Effect Induced Hollow Cylinder Formation in Substitutional Binary Solids: Modeling and Simulation," *Acta Materialia*, 57, 5348-5360, (2009).

H.-Y. Chen, Y. Kwon, and K. Thornton, "Multifunctionality of Three-Dimensional Self-Assembled Composite Structures." *Scripta Materialia*, 61, 52-55, (2009).

H.-C. Yu, A. Van der Ven, and K. Thornton, "Theory of Grain Boundary Diffusion Induced by the Kirkendall Effect," *Applied Physics Letters*, 93, 091908, (2008).

K. Thornton, and H. F. Poulsen, "Three Dimensional Materials Science: An Intersection of Three-Dimensional Reconstructions and Simulations," *MRS Bulletin*, 33, 587, (2008).

H.-C. Yu, D.-H. Yeon, A. Van der Ven, and K. Thornton, "Substitutional Diffusion and Kirkendall Effect in Binary Crystalline Solids Containing Discrete Vacancy Sources and Sinks," *Acta Materialia*, 55, 6690-6704, (2007).

C.M. Funkhouser, F.J. Solis, and K. Thornton, "Coupled Composition-Deformation Phase-Field Method for Biological Membrane," *Physical Review E*, 76, 011912, (2007).

Y. Kwon, K. Thornton, and P.W. Voorhees, "Coarsening of Bicontinuous Structures via Conserved and Nonconserved Dynamics," *Physical Review E*, 75, 021120, (2007).

J.R. Wilson, W. Kobsiriphat, R. Mendoza, H.Y. Chen, J.M. Hiller, D.J. Miller, K. Thornton, P.W. Voorhees, S.B. Adler, and S.A. Barnett, "Three Dimensional Reconstruction of a Solid Oxide Fuel Cell Anode," *Nature Materials*, 5, 541-544, (2006).

D.J. Rowenhorst, J.P. Kuang, K. Thornton, and P.W. Voorhees, "Three-Dimensional Analysis of Particle Coarsening in High Volume Fraction Solid-Liquid Mixtures," *Acta Materialia*, 54, 2027-2039 (2006).

R. Mendoza, K. Thornton, I. Savin, and P.W. Voorhees, "The Evolution of Interfacial Topology During Coarsening," *Acta Materialia*, 54, 743-750, (2006).

Service: Professor Thornton's record of service to the department, College of Engineering, University of Michigan and the broader community has been strong. She has a record of service that is appropriate for her years in rank. She has served on both of the MSE Department's two major committees, the Graduate Committee and Undergraduate Committee, and was intimately involved in the committee activities.

Professor Thornton has been very active in external service, particularly with the organization of five symposia of various types in her field, as well as workshops and panels. She is the first chair of a new TMS committee for Integrated Computational Materials Science, and serves on the TMS Education Committee.

Additionally, she has long been active in outreach activities for young women in the mathematical and scientific fields, and has been strongly involved in outreach since she arrived at the University of Michigan.

External Reviewers:
Reviewer A: "...beyond her technical and professional contributions, Katsuyo is an excellent mentor and role model...I would place Katsuyo in the top 10% of Computational Materials Science Professors active today, with excellent prospects for future professional growth."

Reviewer B: "...one of her strengths is that she focuses as much on development of analytical theories and methods as on modeling and simulation of specific materials systems. This is the hallmark of the very best of those doing materials modeling."

Reviewer C: "...Katsuyo has taken ownership of 3_d computer modeling...mastering the intricacies of the level-set method and the phase-field method. ...[she] is on the same level and impact as that of somewhat more senior researchers in the computational field."

Reviewer D: "I am extremely impressed with [her paper on the famous Kirkendall effect] as I had been trying to do the same thing without success...She rates at the top of her generation of researchers in materials science."

Reviewer E: "...she has already had substantial impact in more than one area, including astrophysics, electrochemical behavior of colloids, three-dimensional image analysis and phase field methods ...the paper on 3-D characterization of fuel cell m materials is a landmark...has accumulated an excellent record in all the aspects that I can address."

Summary of Recommendation: Professor Thornton has made a significant impact on core problems in the discipline of materials science. The CAREER award is an excellent indication of her promise as a researcher and educator. She has been an outstanding citizen and leader serving her department, the university and the professional community. It is with the support of the College of Engineering Executive Committee that I recommend Katsuyo S. Thornton for promotion to associate professor of materials science and engineering, with tenure, Department of Materials Science and Engineering, College of Engineering.

David C. Munson Jr.
David C. Munson, Jr.
Robert J. Vlasic Dean of Engineering
College of Engineering

May 2010