

PROMOTION RECOMMENDATION

The University of Michigan
College of Engineering

Approved by the Regents

May 20, 2010

Shuichi Takayama, associate professor of biomedical engineering, with tenure, Department of Biomedical Engineering, and associate professor of macromolecular science and engineering, without tenure, Macromolecular Science and Engineering Program, College of Engineering, is recommended for promotion to professor of biomedical engineering, with tenure, Department of Biomedical Engineering, and professor of macromolecular science and engineering, without tenure, Macromolecular Science and Engineering Program, College of Engineering.

Academic Degrees:

Ph.D.	1998	The Scripps Research Institute, Chemistry, San Diego, CA
M.Sc.	1994	University of Tokyo, Agriculture, Tokyo
B.Sc.	1992	University of Tokyo, Agriculture, Tokyo

Professional Record:

2006-present	Associate Professor (with tenure), Department of Biomedical Engineering, University of Michigan
2006-present	Associate Professor (without tenure), Macromolecular Science and Engineering Program, University of Michigan
2000-2006	Assistant Professor, Department of Biomedical Engineering, University of Michigan
2000-2006	Assistant Professor, Macromolecular Science and Engineering Program, University of Michigan
1998-2000	Leukemia and Lymphoma Society Postdoctoral Fellow, Harvard University, Cambridge, MA
1998	Postdoctoral Fellow, The Scripps Research Institute, San Diego, CA

Summary of Evaluation:

Teaching: Professor Takayama's teaching record is excellent across all dimensions. He has developed and taught completely new classes, including BME 321, Bioreaction Engineering and Design, which is a core required class for the largest track for the biomedical engineering undergraduate major, and BME 561, Biological Micro- and Nanotechnology, which is a popular graduate-level class. His Q1 and Q2 teaching evaluation scores for the larger undergraduate classes have ranged from 3.60 to a remarkably high 4.72 (average of 4.16 for all semesters) and for the graduate level classes have been consistently between 4.05 and 4.79 (average of 4.41).

In addition to Professor Takayama's classroom instruction, he has an outstanding record of mentoring undergraduate students through directed research projects and graduate students in research. He has chaired or co-chaired 18 doctoral committees. His Ph.D. students have an excellent record of publishing in top journals and going on to take high-level post-graduate and faculty positions at leading institutions. He has advised 11 M.S. students and supervised 12 significant undergraduate research projects. His graduate students uniformly praise him as an excellent mentor and role model in every respect.

Research: Professor Takayama has established a strong international reputation for high quality research. He has over 60 peer-reviewed publications. His intellectual contributions encompass a broad range of topics. These include: i) air-liquid two phase microfluidic systems, ii) reprogrammable microfluidic

systems driven by Braille displays, iii) reconfigurable protein nanopatterning using fracture of polymer supported thin films, iv) tunable nanofluidic systems, v) porous membrane embedded two-layer microchannel networks, and vi) nanoliter reagent using aqueous two phase systems. These technologies have been applied to biomedical topics including: i) development of microfluidic models of small airway injury, ii) development of *in vitro* fertilization chips for the diagnosis and treatment of infertility, iii) reversible on-demand regulation of cell morphology, iv) single molecule DNA manipulation towards applications in epigenetic analysis, v) study of breast and prostate cancer signaling and metastasis, and vi) cellular microarrays for high-throughput gene expression and knockdown.

External funding for his research program is both extensive and varied, with NIH RO1 grants as well as grants from NSF and multiple other foundations. Many of his grants are with colleagues, highlighting his strong commitment to interdisciplinary research. His colleagues freely credit the essential core intellectual contributions made by Professor Takayama on his interdisciplinary projects.

Recent and Significant Publications:

- Tavana, H., Jovic, A., Mosadegh, B., Yi, L.Q., Liu, X., Luker, K. E., Luker, G. D., Weiss, S. J. and Takayama, S., "Microliquid Printing and Application to Spatial Control of Gene Expression in Mammalian Cells," *Nature Materials*, 2009, 8, 736-741.
- Song, J. W., Cavnar, S. P., Walker, A. C., Luker, K. E., Gupta, M., Tung, Y.-C., Luker, G. D. and Takayama, S., "Microfluidic Endothelium for Studying the Intravascular Adhesion of Metastatic Breast Cancer Cells," *PLoS One*, 2009, 4, e5756.
- Uchida, T., Mills, K. L., Kuo, C.H., Tung, Y.-C., Thouless, M.D. and Takayama, S., "External Compression-induced Fracture Patterning on the Surface of Poly(dimethylsiloxane) Cubes and Microspheres," *Langmuir*, 2009, 25, 3102-3107.
- Huh, D., Fujioka, H., Tung, Y.-C., Futai, N., Paine, R., Grotberg, J. B. and Takayama, S., "Acoustically Detectable Cellular-Level Lung Injury Induced by Fluid Mechanical Stresses in Microfluidic Airway Systems," *Proceedings of the National Academy of Sciences United States of America*, 2007, 104, 18886-18891.
- Huh, D., Mills, K. L., Zhu, X., Burns, M. A., Thouless, M. D. and Takayama, S., "Reconfigurable Elastic Nanochannels for Tunable Nanofluidic Manipulation," *Nature Materials*, 2007, 6, 424-428.
- Gu, W., Zhu, X., Futai, N., Cho, B. S. and Takayama, S., "Computerized Microfluidic Cell Culture Using Elastomeric Channels and Braille Displays," *Proceedings of the National Academy of Sciences United States of America*, 2004, 101, 15861-15866.

Service: Professor Takayama's service record is excellent. He is currently serving on six internal committees, having served on 22 committees since joining the department. His input on issues of faculty hiring and promotion is always sought and is highly respected. He is one of the most selfless and tireless citizens of the Biomedical Engineering Department. His external service record is equally strong. He has served on many national-level grant review panels for both NIH and NSF. He is a tireless reviewer for many excellent journals, and he has served as a session chair and discussion leader for many research conferences. His external service has been noted and appreciated by his external reviewers.

External Reviewers:

Reviewer A: "Prof. Takayama is internationally recognized for his work on engineering cellular environment using microfluidic techniques. His work is always creative, clever, and of high quality, and with very well grounded applications to pertinent problems in biology...in comparison with his peers, I believe Prof. Takayama ranks near the top where many already are at the rank of Full Professor."

Reviewer B: "...he developed an important tool for microfluidic experiments, that is, a new fluidic control system using Braille displays...his standing in his peer group should be recognized at the top level."

Reviewer C: "I am impressed with Prof. Takayama's work on control of cellular microenvironments, and other applications of microfluidics. The papers that were included are top-notch, of the kind 'why didn't I think of that'."

Reviewer D: "The tunable nanochannels paper describes a novel technique for actively manipulating nanofluidic transport via dynamically modulating the cross-section of the channel. This technique provides a valuable tool for manipulating biological molecules, which may play a key role in the future by aiding scientists in acquiring a better fundamental knowledge on the properties of biomolecules."

Reviewer E: "...Dr. Takayama is one of the most creative scientists in the field of microfluidics. He has a unique ability to select exciting problems and then tackle them in a very innovative manner at the interface of microtechnology and life sciences....Equally important as his creative ideas, Dr. Takayama's work is also of the highest quality and rigor."

Reviewer F: "I would say that Prof. Takayama is in the top echelons of his peer group, for a number of reasons. 1) He has produced several outstanding examples of microfluidics for cell studies... 2) He is one of those unique individuals who has demonstrated confidence in working with technology development (now extending to nanotechnology) as well as applications 3) He has a detailed understanding of the areas he is working in, which he conveys in very intelligently written papers."

Summary of Recommendation: Professor Takayama has established a strong international reputation for high quality research. He is a dedicated teacher and mentor to both graduate and undergraduate students. Professor Takayama is a selfless and tireless citizen in his service to his department and his profession. It is with the support of the College of Engineering Executive Committee that I recommend Shuichi Takayama for promotion to professor of biomedical engineering, with tenure, Department of Biomedical Engineering, and professor of macromolecular science and engineering, without tenure, Macromolecular Science and Engineering Program, College of Engineering.



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

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