PROMOTION RECOMMENDATION
The University of Michigan
College of Engineering
Department of Chemical Engineering

Bryan Goldsmith, assistant professor of chemical engineering, Department of Chemical Engineering, College of Engineering, is recommended for promotion to associate professor of chemical engineering, with tenure, Department of Chemical Engineering, College of Engineering.

Academic Degrees:
Ph.D.   2015   Chemical Engineering, University of California, Santa Barbara, CA
B.S.   2010   Chemical Engineering, University of California, Riverside, CA

Professional Record:
2020 – present   Dow Corning Assistant Professor, Chemical Engineering, University of Michigan
2017 – 2020   Assistant Professor, Chemical Engineering, University of Michigan
2015 – 2017   Post-doctoral Research Fellow, Theory Department, Fritz Haber Institute of the Max Planck Society, Berlin, Germany

Summary of Evaluation:
Teaching: Professor Goldsmith is an excellent teacher and mentor to both graduate and undergraduate students. He taught the core introductory course ChE 230 *Introduction to Material and Energy Balances* four times with excellent scores. This is the first course for ChE undergraduate students, and a crucial course to keep students interested in ChE and to provide the solid background needed for subsequent courses. He also developed and taught two new courses: a section of ENG 100, our freshman course, and a graduate course, both on applications of data science in engineering. Professor Goldsmith is devoted to promoting his student's education and careers and was nominated by them for the Golden Apple award and the Advising Council Outstanding Advisor Award. He has advised eight PhD students, four master's students and 19 undergraduates in research. Several of his students have received various awards under his guidance, ranging from external graduate fellowships to first-place student poster awards for undergraduates. His teaching-related outreach activities focus on first-generation college students and inclusion in STEM, and include a seminar delivered to the UM Tau Beta Pi chapter on career development and the transition between college and graduate schools and contributing to the National Chemical Engineering Process Safety Curriculum Initiative.

Research: Professor Goldsmith is a recognized leader in the use of quantum chemical first principles computational techniques, molecular simulation, and machine learning to understand catalytic systems and advanced materials for use in air and water pollution reduction, sustainable fuel production, and energy storage and generation. He has made significant contributions in several research areas. A notable example is his recent work on electrochemical ammonia synthesis over perovskite oxynitrides (*J. Phys. Chem.* C 2022), unique materials that are sufficiently conductive to be used as electrodes in an electrochemical system and sufficiently

stable under harsh reaction conditions. The paper gives an excellent overview of current challenges for electrochemical ammonia synthesis and provides instructive pathways for tuning the geometry of these materials to optimize selectivity and activity. Another area of research where Professor Goldsmith is making impact is related to the electrochemical reduction of nitrates, addressing a critical environmental problem brought about by overfertilization in the agricultural industry. In their paper in *Catalysis Science and Technology* (2021), the groups of Goldsmith and Singh addressed both nitrate pollution and difficult to-do low-temperature ammonia synthesis (fertilizer production) in a single catalytic system, overcoming long-standing difficulties in synthesizing ammonia from N_2, the traditional feedstock for this process. Professor Goldsmith has funded his research efforts through multiple grants from industry and governmental sources, including Microsoft, the Department of Defense, the National Science Foundation, the Department of Energy, and the American Chemical Society's Petroleum Research Fund.

Professor Goldsmith has published 38 journal articles and one conference proceeding paper. His papers have been cited 2,221 times and he has an h-index of 21 (per Google Scholar). He has raised $1.6M to fund his research through a combination of single PI and collaborative proposals on which he serves as the lead PI or co-PI, and he was recently recommended for a prestigious NSF Career Award.

Recent and Significant Publications:
Jacques Esterhuizen, Jin-Xun Liu, Christopher J. Bartel, Christopher Sutton, Bryan R. Goldsmith "Machine learning for heterogeneous catalyst design and discovery," *AIChE Journal*. 05/2018; 64(7): 2311.
Hui Wang, Jin-Xun Liu, Lawrence F. Allard, Sungsik Lee, Jilei Liu, Hang Li, Wei Li, Jianqiang Wang, Jun Wang, Se H. Oh, Maria Flytzani-Stephanopoulos, Meiqing Shen, Bryan R. Goldsmith, Ming Yang, "Surpassing the single-atom catalytic activity limit through a Pt-O-Pt ensemble built from isolated Pt1 atoms," *Nature Communications*. 08/2019; 10(1): 1.
Jin-Xun Liu, Danielle Richards, Nirala Singh, Bryan R. Goldsmith, "Activity and selectivity trends in electrocatalytic nitrate reduction on transition metals," *ACS Catalysis*. 06/2019; 9(8): 7052-7064.
Francis Doherty, Bryan R Goldsmith, "Rhodium single-atom catalysts on titania for reverse water gas shift reaction explored by first principles mechanistic analysis and compared to nanoclusters," *ChemCatChem*. 04/2021; 13: 3155.
Jacob Florian, Harsh Agarwal, Nirala Singh, Bryan R. Goldsmith, "Why halides enhance heterogeneous metal ion charge transfer reactions," *Chemical Science*. 08/2021; 12: 12704-12710.

Service: Professor Goldsmith's service to the profession includes session and symposium organizer at both the American Institute for Chemical Engineers (AIChE) and American Chemical Society annual meetings each year of his current appointment in multiple topics related to catalysis and machine learning (ML). He currently serves as the president of the Michigan Catalysis Society, having served in several other elected roles over the past few years. He was a conference organizer for the North American Catalysis Society (NACS), and the primary conference organizer for the 42nd Michigan Catalysis Society, a subset of NACS. At the college

and campus levels, he has been the college representative for several faculty interviews, served as a member of Project TableSaw and served in an advisory capacity for Michigan Institute for Data Science. At the department level, Professor Goldsmith is an elected member of the ChE's external advisory committee, a member of the graduate admissions committee, and faculty advisor to our American Institute for Chemical Engineers student chapter.

External Reviewers:
Reviewer A: "Compared with other tenure track assistant professors in the research field and who received their PhDs in 2015, I would think that Bryan Goldsmith ranks in the absolute top."

Reviewer B: "As an article reviewer, I have noted the rigor at which computational chemistry techniques are applied, and I have forwarded these results to my group members to consider in their research projects."

Reviewer C: "…BRG has a distinguished research, teaching, mentoring and service record. I think he has a bright future and certainly merits promotion and tenure at a top program like ChE at UM."

Reviewer D: "Dr. Goldsmith stands among his peers in the field. I consider him to have a leadership position among them in the areas of interpretable machine learning and its applications in catalysis. I only know of a few other comparable peers in developing the data science curriculum…"

Reviewer E: "Goldsmith stands out among his peers for his emphasis on using his theory to impact catalysis practice. He has avoided the tendency of some to pursue models, in particular machine learning models, as an end rather than a means. Further, he has chosen collaborators wisely and worked with them to contribute to important and challenging (electro)catalysis problems."

Summary of Recommendation: Professor Goldsmith has established himself as a leader in the field of various applying machine learning algorithms to the fields of catalysis and electrocatalysis. It is with the support of the College of Engineering Executive Committee that I recommend Bryan Goldsmith for promotion to associate professor of chemical engineering, with tenure, Department of Chemical Engineering, College of Engineering.

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Alec D. Gallimore, Ph.D.
Robert J. Vlasic Dean of Engineering
College of Engineering

May 2023