Markus J. Buehler, Ph.D.
Mechanical Engineering & Civil and Environmental Engineering
McAfee Professor of Engineering
Massachusetts Institute of Technology
Director and PI, Laboratory for Atomistic and Molecular Mechanics (LAMM)
Lab URL: http://lamm.mit.edu/
Personal website: https://meche.mit.edu/people/faculty/mbuehler@mit.edu
mbuehler@MIT.EDU

EXECUTIVE SUMMARY

Markus J. Buehler is the McAfee Professor of Engineering at MIT (an Institute-wide Endowed Chair), a member of the Center for Materials Science and Engineering, and the Center for Computational Science and Engineering at the Schwarzman College of Computing. He holds academic appointments in Mechanical Engineering and Civil and Environmental Engineering. In his research, Professor Buehler pursues new modeling, design and manufacturing approaches for advanced biomaterials that offer greater resilience and a wide range of controllable properties from the nano- to the macroscale. His interests include a variety of functional material properties including mechanical, optical and biological, linking chemical features, hierarchical and multiscale structures, to performance in the context of physiological, pathological and other extreme conditions. His methods include molecular and multiscale modeling, design, as well as experimental synthesis and characterization. His particular interest lies in the mechanics of complex hierarchical materials with features across scales (e.g. nanotubes, graphene and natural biomaterial nanostructures including protein materials such as intermediate filaments and hair, collagen, silk and elastin, and other structural biomaterials). An expert in computational materials science and AI, he has pioneered the field of materiomics, and demonstrated broad impacts in the study of mechanical properties of complex materials, including predictive materials design and manufacturing. Between 2013-2020, Buehler served as Department Head of MIT's Civil and Environmental Engineering Department. He has held numerous other leadership roles at professional organizations, including a term as President of the Society of Engineering Science (SES).

ADDITIONAL BACKGROUND

Prof. Buehler has authored more than 500 peer-reviewed publications (H-index=103), which have been cited more than 38,000 times, and authored two monographs (as well as several edited books). He has given more than 400 invited/keynote/plenary talks around the world, and given several highly-praised TED talks. His technical innovations have resulted in several patents. Buehler's recent research has resulted in a new paradigm for the analysis of bio-inspired materials and structures to devise new biomaterial platforms, and using a mathematical categorization approach that connects insights from disparate fields such as materials, structures to music and language. His work also includes the introduction of AI methods in materials modeling and design, especially fracture mechanics, featuring a novel perspective to connect datasets form experiment and simulation to develop multiscale models. He has applied these methods to wide ranging areas of application including protein folding, fracture, and composite design, and coupled the *de novo* design methods with additive manufacturing approaches. He is well-known for his research on mechanically relevant proteins, especially silk, elastin, intermediate filaments, and collagen.

He is the Editor in Chief of the *Journal of the Mechanical Behavior of Biomedical Materials* (since his inaugural appointment, the impact factor increased from 2.876 to 4.042). He was recently elected as the inaugural Section Editor of *MRS Bulletin Impact* by the Materials Research Society, and is active on the editorial board of many other top-ranked peer-reviewed journals, such as *APL Machine Learning, Extreme Mechanics Letters, Biophysical Journal,* and *Computational Materials Science*.

Buehler has served in numerous leadership roles, including as an elected member of the Board of Directors of the Society of Engineering Science (SES) (2016-2018) and between 2018 and 2020 served as President-elect, President and Past President of the SES. He served as the chair of several conferences (including the ASME Global Congress on NanoEngineering for Medicine and Biology meeting in 2013, several times as Chair/Co-Chair of the International Conference on Mechanics of Biomaterials & Tissues). He served as the inaugural chair of the ASCE Biomechanics Committee and on the Executive Committee of the ASME Materials Division (2015-2018). In addition to various other committees in professional organizations, Buehler is actively involved in public outreach. He offers an annual mechanics and materials research camp at MIT with local middle and high schools, funded by the U.S. Army Educational Outreach Program (AEOP) and UNITE program. The program featured 46 students in 2022, with a 45% female and/or URM participation. He served as MRS Fall 2021 Meeting Chair, one of the largest materials research conferences and has organized many other workshops and symposia.

Buehler is an accomplished academic leader and administrator. Between 2013-2020, Buehler served as

Department Head of MIT's Civil and Environmental Engineering Department. His leadership resulted in an increase in rankings (US News & World ranking increased from 8 to 3; ranking in QS World University Rankings consistently 1), the development of a new undergraduate curriculum, extensive space renovations and fundraising. Buehler led a faculty hiring campaign and renewed around 1/3 of the department faculty resulting in 12 new faculty hires (7 women and 2 URM faculty; overall 58% female/URM). At the end of his tenure CEE had the second highest ratio of female faculty in the MIT School of Engineering. During his tenure, Buehler appointed the first female and the first African American Associate Department Head. To identify, promote and recruit female star researchers pursuing faculty-track careers, he introduced the Rising Stars program.

He is the recipient of many awards including the ASME Drucker Medal, the Feynman Prize, the IACM Fellows Award, the J.R. Rice Medal, the Harold E. Edgerton Faculty Achievement Award, the Alfred Noble Prize, the Leonardo da Vinci Award, and the Thomas J.R. Hughes Young Investigator Award, and many others. He further received numerous government agency recognitions, including the National Science Foundation CAREER award, the United States Air Force Young Investigator Award, the Navy Young Investigator Award, the Defense Advanced Research Projects Agency (DARPA) Young Faculty Award, as well as the Presidential Early Career Award for Scientists and Engineers (PECASE). He has been selected as a Clarivate Highly Cited Researcher. In 2020, he was named as one of the global top 0.09% of all researchers worldwide in the nanoscience category in a study from Stanford University.

In addition to his teaching at MIT, he offers two annual Professional Education courses on "*Predictive Multiscale Materials Design*" and "*Machine Learning for Materials Informatics*". These courses have been taken by more than 150 engineering, scientific and other professionals. Based on his record in the translation of basic research into practice through entrepreneurship, Buehler is involved with startups and innovation, such as through his role on the Board of Directors of Sweetwater Energy, Inc. and as a member of the Scientific Advisor Board of Safar Partners (A Technology Venture Fund). He has experience in scientific and engineering consulting for industry, government agencies, and as expert witness for a variety of technologies, in particular materials science and mechanical properties, including fracture. In his work at MIT he has collaborated with numerous corporate partners, including BASF (development of novel additives for road pavements), Teledyne (development of thermal/mechanical heat dissipation strategies using nanotubes), Henkel (development of adhesive designs), and Ferrovial/Cadagua (development of technologies to translate organic waste to structural materials).

As a composer of classical and experimental music with a special interest in science-based sonification, he is active in scientific outreach and the intersection of art and science, and a member of the Executive Committee of MIT's Center for Art, Science and Technology (CAST). His work has resulted in contributions to exhibitions and performances at international art venues (e.g. Palais de Tokyo, Guggenheim/e-flux, Harvard Arts First Festival). In 2022, his work was also incorporated into the collection of the Library of Congress, Music Division.