THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT
FALL COLLOQUIUM SERIES PRESENTS:

Professor Nitin Padture

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The Promise of Rigid and Flexible Halide-Perovskite Photovoltaics

Renewable electricity from solar photovoltaics (PV), combined with low-cost large-scale storage, is likely to play a dominating role in decarbonizing the expanding global power sector in the long run. For example, the global deployment of PV is targeted at ~75 TW installed capacity by 2050, from the current (2024) ~2 TW. While currently used PV technologies are efficient, reliable, and relatively cheap, there is, and always will be, insatiable demand for new PV technologies that are more efficient and cost-effective, and importantly, have a smaller 'carbon-footprint.' In this context, the promising new halide-perovskite PV technology, where the thin-film PV can be mechanically rigid or flexible, has the potential to meet all those requirements. Also, lightweight flexible perovskite PV are more versatile, where they can be used to power internet-of-things, vehicles, satellites, portable supplies, *etc.*, in addition to rooftop and utility-scale applications. While the record power-conversion efficiency of perovskite PV now rivals that of conventional silicon PV, durability and mechanical reliability are becoming 'bottleneck' challenges in perovskite PV. To address some of these technical hurdles in the path towards their commercialization, we have researched several rationally-designed microstructural and interfacial tailoring approaches. These include grain-coarsening, grain-boundary functionalization, and engineering of interfaces and substrates. Most importantly, these approaches are designed to not only enhance the PVs' mechanical performance but also increase efficiency and improve durability simultaneously. The scientific rationales for these approaches will be discussed, together with the presentation of current results.

Nitin P. Padture is the Otis E. Randall University Professor in the School of Engineering, and founding Director of the Initiative for Sustainable Energy, at Brown University. Previously he served as Director of Brown's Institute for Molecular and Nanoscale Innovation for eight years. Prior to January 2012, Padture was College of Engineering Distinguished Professor at The Ohio State University (OSU), and founding Director of the NSF-funded Materials Research Science and Engineering Center (MRSEC) at OSU. Prior to January 2005 he was on the University of Connecticut (UConn) faculty for 10 years, following a 3-year postdoc stint at the National Institute of Standards and Technology (NIST). Padture holds a B.Tech. from the Indian Institute of Techology - Bombay (IIT-B), M.S. from Alfred University, and Ph.D. from Lehigh University. His research and teaching interests are in the broad areas of advanced ceramics, semiconductors, and nanomaterials used in applications ranging from jet engines to solar cells. Padture is author or co-author of over 300 publications, which have been widely cited. He is Fellow of the American Ceramic Society, the American Association for the Advancement of Science, and the Materials Research Society. Padture has received several other awards over the years, including Robert L. Coble and Richard M. Fulrath awards from the American Ceramic Society; Distinguished Alumnus Award from IIT-B; and the Brown University Presidential Faculty Award. Padture is Editor of the journals *Acta Materialia* and *Scripta Materialia*.

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In person only; no Zoom

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