Opening Plenary Session

Monday, May 5, Morning

8:30 – 8:35	Mingda Li, Chair, APS Users' Executive Committee (Massachusetts Institute of Technology) and Preston Snee, Vice-Chair, CNM Users' Executive Committee (University of Illinois at Chicago) *Welcome and Launch of the 2025 APS/CNM Users Meeting*
8:35 – 8:45	Paul K. Kearns, Laboratory Director (Argonne National Laboratory) *Welcome from the Laboratory*
8:45 – 8:50	Laurent Chapon, Associate Laboratory Director, Photon Sciences (Advanced Photon Source, Argonne National Laboratory) *Introduction of DOE Speaker TBD*
8:50 – 9:15	Andrew Schwartz (Deputy Associate Director, Basic Energy Sciences, Office of Science, U.S. Department of Energy) *The DOE Perspective*
9:15 – 9:20	Gary Wiederrecht, Interim Division Director (Center for Nanoscale Materials and the Nanoscience and Technology Division, Argonne National Laboratory) *Introduction of Keynote Speaker Ting Zhu*
9:20 – 10:10	Keynote Address: Ting Zhu (George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology) *Mechanics of Extremely Heterogeneous Materials*
10:10 – 10:35	Break
10:35 – 10:55	Laurent Chapon, Associate Laboratory Director, Photon Sciences (Advanced Photon Source, Argonne National Laboratory) *APS Update*
10:55 – 11:15	Gary Wiederrecht, Interim Division Director (Center for Nanoscale Materials and the Nanoscience and Technology Division, Argonne National Laboratory) *CNM Update*
11:15	Adjourn

Mechanics of Extremely Heterogeneous Materials

Ting Zhu[1]

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Our recent studies on additively manufactured alloys (*Nature*, 608, 62–68, 2022), high-entropy alloys with nanoscale chemical modulation (*Nature*, 574, 223-227, 2019), gradient nanotwinned metals (*PNAS*, 119, e2116808119, 2022), and other heterogeneous materials raise fundamental questions about how extremely fine microstructural heterogeneities influence the mechanical behavior of these novel material systems. By integrating experimental characterization and mechanics modeling, we uncover the extra strengthening effects of these microstructural heterogeneities compared to their homogeneous counterparts. Quantitative comparisons between experimental and modeling results reveal previously underappreciated mechanisms governing materials with extremely complex microstructures. Furthermore, we have leveraged new experimental methods, including *in-situ* atomic-resolution TEM of grain boundary deformation (*Science*, 375, 1261–1265, 2022) and *in-situ* synchrotron x-ray microdiffraction (*PNAS*, 115, 483-488, 2018), to push the boundaries of microstructural characterization across different length scales. These studies provide mechanistic insights for designing high-performance materials with extremely heterogeneous microstructures.