Stanford

Molly McFadden

Acting Assistant Professor, Materials Science and Engineering

Bio

BIO

Molly McFadden is an incoming assistant professor in the department of Materials Science and Engineering at Stanford University (beginning January 2027). The McFadden research group works at the interface of materials science and synthetic chemistry, using strain-promoted reactions to enable both new syntheses and new applications of soft materials. Her research combines transition-metal catalysis, polymer synthesis, and holistic materials characterization to link a polymer's primary structure and its mechanical response.

Plastics are subject to mechanical forces at every stage of their lives, from synthesis and processing to their use lifetime and ultimately to their recycling. These forces are usually treated as a liability: both extrusion and strain during use break chains, degrading the material. The McFadden group instead treats strain as a strategic and synthetic tool. Force acts across every length scale, impacting everything from the bulk properties and integrity of a material down to the electronic structure of a single bond. Further, the electronic impact of elongational strain accessible in polymer backbones remains far less understood than the contracted angular strain in small cyclic molecules known to enable unique reactivity. Force-responsive molecular switches, or mechanophores, let a material report on the stress it experiences, both as tools to map how stress propagates through soft materials and as the basis for stimuli-responsive materials with applications from smart plastics to biomedical sensing and therapeutics. The group uses catalytic and molecular approaches to understand these forces, to prevent the damage they cause, and ultimately to harness their energy to drive productive reactions to discover and synthesize new materials.

Prior to joining Stanford, Prof. McFadden was a Kathryn A. Day Miller Postdoctoral Research Fellow at the University of California, Berkeley, working with Prof. John Hartwig on selective transition-metal-catalyzed C–H functionalization of commodity polyolefins to yield more sustainable plastics. She received her B.S. in Biochemistry from Indiana University and her Ph.D. in Chemistry from Caltech, where she worked with Prof. Maxwell Robb on the design of molecular mechanophores for force-responsive polymeric materials.