

IRG-1, Northwestern University MRSEC

Northwestern University IRG-1 has identified novel protein building blocks that form high-aspect ratio structures with genetic-level programmability and tunability. For example, one building block gives rise to structures up to hundreds of microns in length yet only 20 nanometers in diameter, while another gives rise to regular hexagons of up to 40 microns in diameter but only 10 microns thick. These features are tuned by single amino acid mutations in the building block, which impact charge and size of the protein at key interfaces. Molecular dynamics simulations of the structures, requiring one to three million atoms per simulation, reveal the role of charge perturbations even when the mutation is far from the interface. By understanding the biophysics underlying such structural forms, IRG-1 is using these building blocks as key active components in tunable matrix materials such that the material can be mechanically strengthened or weakened upon the addition of a stimulus that impacts these interactions.

