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Expanded experimental parameter space of semiflexible polymer assemblies through programmable nanomaterials DAVID SMITH, CARSTEN SCHULDT, JESSICA LORENZ, TERESA TSCHIRNER, MAXIMILIAN MOEBIUS-WINKLER, Fraunhofer Institute for Cell Therapy and Immunology, JOSEF KAES, MARTIN GLASER, TINA HAENDLER, JOERG SCHNAUSS, University of Leipzig, Institute for Soft Matter Physics — Biologically evolved materials are often used as inspiration in the development of new materials as well as examinations into the underlying physical principles governing their behavior. For instance, the biopolymer constituents of the highly dynamic cellular cytoskeleton such as actin have inspired a deep understanding of soft polymer-based materials. However, the molecular toolbox provided by biological systems has been evolutionarily optimized to carry out the necessary functions of cells, and the inability modify basic properties such as biopolymer stiffness hinders a meticulous examination of parameter space. Using actin as inspiration, we circumvent these limitations using model systems assembled from programmable materials such as DNA. Nanorods with comparable, but controllable dimensions and mechanical properties as actin can be constructed from small sets of specially designed DNA strands. In entangled gels, these allow us to systematically determine the dependence of network mechanical properties on parameters such as persistence length and crosslink strength. At higher concentrations in the presence of local attractive forces, we see a transition to highly-ordered bundled and "aster" phases similar to those previously characterized in systems of actin or microtubules.

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