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Dual-Colored DNA Comb Polymers for Single Molecule Rheology

DANIELLE MAI, AMANDA MARCIEL, CHARLES SCHROEDER, University of Illinois at Urbana-Champaign — We report the synthesis and characterization of branched biopolymers for single molecule rheology. In our work, we utilize a hybrid enzymatic-synthetic approach to graft "short" DNA branches to "long" DNA backbones, thereby producing macromolecular DNA comb polymers. The branches and backbones are synthesized via polymerase chain reaction with chemically modified deoxyribonucleotides (dNTPs): "short" branches consist of Cy5-labeled dNTPs and a terminal azide group, and "long" backbones contain dibenzylcyclooctyne-modified (DBCO) dNTPs. In this way, we utilize strain-promoted, copper-free cycloaddition "click" reactions for facile grafting of azide-terminated branches at DBCO sites along backbones. Copper-free click reactions are bio-orthogonal and nearly quantitative when carried out under mild conditions. Moreover, comb polymers can be labeled with an intercalating dye (e.g., YOYO) for dual-color fluorescence imaging. We characterized these materials using gel electrophoresis, HPLC, and optical microscopy, with atomic force microscopy in progress. Overall, DNA combs are suitable for single molecule dynamics, and in this way, our work holds the potential to improve our understanding of topologically complex polymer melts and solutions.

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