Synthesis of DNA Triblock Copolymer Using Restriction and Ligation Enzymes

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Hybrid polymers containing both biological and synthetic segments have attracted much interest in recent years. In particular, DNA containing block copolymers are expected to find utility in a wide range of biomedical applications. In this study, we report the use of a combination of restriction enzyme and ligation enzyme to generate novel DNA hybrid material with a triblock copolymer structure. In this method, two DNA diblock copolymers are designed to contain complementary sticky end of restriction enzyme site. One of the two diblocks is connected to gold nanoparticles (AuNPs) to facilitate the removal of excess DNA fragments. The two complementary DNA segments are then connected in the presence of ligation enzyme to generate the desired triblock copolymer. The triblocks are unique in the sense that all the segments are connected by covalent bond such that they remain stable even when heated to high temperatures. More importantly, we show that by using the cut and paste technique, the triblock copolymer can also be digested to regenerate the diblocks, thus allowing the material to be recycled for the generation of a different triblock copolymer.