Development of DNA Circuits Using 3-cyanovinylcarbazole Induced Ultra-fast Photo-crosslinking

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Keywords: DNA memory circuit; DNA photo-cross-linker

Nucleic acid has been widely studied and used as a biological engineering material. It follows Watson-Crick base pairing method, which makes it highly predictable and programmable for constructing various nano-scaled molecular devices. In our previous study, we have designed a photo-induced DNA memory system that can reflect the order of input DNA. The ultra-fast photo-cross-linker, 3-Cyanovinylcarbazolenucleoside (^{CNV}K)[1,2], were inserted in the input probes to achieve photo-control and it also played an important role improving the efficiency of the system.

In this study, we designed a new scheme of DNA circuit reflecting the input order that only functions with photo-regulation while achieving waste control. The circuit is constructed with a DNA hairpin memory gate and 2 linear input strands. When the input strands are added in sequential order, input 1 can invade hairpin stem with photo-energy by forming cross-link. Input 2 added later can then invade the rest of the hairpin stem by photo-cross-linking. Whereas with reverse order, input 2 added first will stay as free strand and cross-link to the later added input 1 under photo-irradiation. This circuit can be reused till it meets sequential inputs. Since the cross-link forms under 366 nm photo-irradiation and only reversable at 312 nm irradiation, this circuit also expected to achieve waste controlling. We aim to construct a photo-induced memory circuit that can compute the input order with high-speed while preventing undesired complexes through high cross-linking rate.

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