D 4.1 Investigation of multi-state time-dependent programmed DNA devices on DNA machines. M12, WP4

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Interlocked DNA nanostructures undergoing input-driven dynamic topological transitions were developed. Nucleic acid strands act as fuels/anti-fuels to transform the devices across distinct states. The fluorescent features of the systems identify the different states of the devices. The input-driven time-dependent fluorescence changes of the system represent the switchable multi-states of the systems. We describe the assembly of a five-ring interlocked catenane DNA system, Figure 4.1(A). The system undergoes switchable, cyclic and reversible, transitions across four states, where one of the states is represented by the olympiadane five-ring configuration. Figure 4.1(B) shows the dynamic transition across the states.

A further DNA machine was assembled using an interlocked DNA ring stoppered in a rotaxane structure by two 10-nm-sized Au nanoparticles. The input-driven transition of the DNA ring between two states is followed by the fluorescence features of fluorophores associated with the ring. Fluorescence quenching of the fluorophore or plasmonic fluorescence enhancement of the fluorophore define the state of the device. By combining different rotaxanes and different fluorophores the parallel addressing and imaging of different states is feasible.