Optomagnetic studies of triplex dna nanoswitches

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Magnetic bead-based DNA processing provides a basic principle for DNA selection [1] that was used in microreactors for DNA computing [2]. A combination of DNA self-assembled nanostructures with pH switching of DNA conformations may lead to pH-dependent delivery systems and artificial cell architectures. We report on the switching of magnetic nanobead (MNB) clusters via DNA triplex structures (Fig. 1a) detected using an optomagnetic technique. The 2nd harmonic modulation of 405 nm laser light transmitted through the sample container is measured as a function of the frequency $f$ of an applied oscillating magnetic field (Fig. 1b). This modulation arises from the coupled magnetic and optical anisotropies of 100 nm MNBs. The frequency spectra reflect the rotation response of the MNBs and show characteristic features at frequencies related to their inverse hydrodynamic size that allows one to detect DNA-target induced agglutination of different populations of MNBs [3]. Here, we use a single population of MNBs functionalized with palindromic polypyrimidine DNA oligonucleotides that may spontaneously fold in the presence of polypurine DNA to form a triplex structure that links MNBs (Fig. 1a).

In conclusion, we present triplex DNA nanoswitches with a sensitive lock-in based detection scheme of polypurine DNA target. Reversible DNA immobilization on MNBS with sensitive optical detection may provide a useful building block in DNA computation architectures. This work was supported by FP7 projects ECCell (#222422), MATCHIT (#249032), and DFF project (#4184-00121B).