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Chemical Biology that Controls DNA Structure and Function

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DNA is one of the most promising molecules for preparing various self-assembled components and large scaffolds for the production of complicated patterns, and for placing and arranging functional molecules and nanomaterials. The novel DNA self-assembly system “DNA Origami” is an attractive strategy for the construction of fully addressable 2D plate and also making a wide variety of designs for 2D structural patterns which can be a powerful tool in chemical biology [1,2]. Our researches focused on the selective positioning of the functional molecules on the DNA scaffolds, and analysis of dynamic movement of single molecules on the DNA nanostructure. The expression of functions by positioning the molecules can also be carried out in the defined nano-scale space. The high-speed AFM instruments make it possible to observe the image of single molecular dynamics in the nano-scale space. We constructed the nano-space using the novel designed DNA scaffold “DNA frame”, which can allow the connection of two different duplex strand. Using the different length of duplexes, the dynamic movement of the DNAs and the single enzyme, such as EcoRI methyltransferase binding onto the specific DNA can be observed. The methylation reaction can be controlled using the different lengths of the duplexes in the DNA frame, which possess the tense and relaxed double helices. The DNA nanostructures developed in our research can be used to observe and analyze the single molecular reactions and dynamics in a designed nano-scale space.

[1] P. W. K. Rothemund, Nature, 2006, 440, 297.

[2] M. Endo, H Sugiyama, Chem.Bio.Chem. in press.