

|              |   |
|--------------|---|
| Title        | 超高速光架橋反応を用いたDNAナノ工学   |
| Author(s)    | 中村, 重孝  |
| Citation     |   |
| Issue Date   | 2015-03   |
| Type         | Thesis or Dissertation  |
| Text version | ETD   |
| URL          | <a href="http://hdl.handle.net/10119/12775">http://hdl.handle.net/10119/12775</a> |
| Rights       |   |
| Description  | Supervisor: 藤本 健造, マテリアルサイエンス研究科, 博士  |

## Abstract

1240010 Nakamura Shigetaka

3-cyanovinylcarbazole nucleotide (<sup>CNV</sup>K) has high photoresponsive ability, whereby the ODN containing <sup>CNV</sup>K is photocrosslinked to complementary DNA with 366 nm for a few seconds. I focused on a change of structure, creation of a covalent bond following [2+2] photocyclization using <sup>CNV</sup>K, and it has high photoresponsive ability; these characteristics were adapted to DNA nanotechnology to create an application that has a function unrealizable only with a native base.

In chapter 1, I demonstrated the photopolymerization of ODNs using <sup>CNV</sup>K mediated DNA photocrosslinking. A stable DNA photopolymer was successfully created from short ODNs rapidly by irradiation at 366 nm, and its photopolymer was degraded to start short ODNs with a 312 nm irradiation. And, this photopolymerization can create a DNA-RNA hetero polymer incorporating miRNA in a sequence specific manner.

In chapter 2, I tried to create a DNA array structure equipped with heat resistance focused on the creation of a covalent bond using the photocrosslinking reaction with <sup>CNV</sup>K. The simple DNA array became a very stable structure which is not broken under conditions of heating and denaturing by photocrosslinking. Moreover, the inserting position and number of <sup>CNV</sup>K allow regulation of the size and conformation of the DNA array.

In chapter 3, I demonstrated the chemical shift imaging of nucleic acids using DNA photocrosslinking of <sup>CNV</sup>K. The <sup>19</sup>F MR signal was shifted -63.2 to -71.2 ppm by the change of spatial proximity and electronic state in trifluoromethyl group using DNA photocrosslinking with <sup>CNV</sup>K. And, it was successful the detection of 10 nM miRNA using <sup>19</sup>F chemical shift imaging mediated HCR in sequence specific manner.

In chapter 4, I demonstrated the feasibility of acceleration of DNA strand displacement by ultrafast DNA photocrosslinking with <sup>CNV</sup>K. The DNA strand displacement was accelerated by DNA photocrosslinking. The inserting position of <sup>CNV</sup>K greatly affected the acceleration effect about DNA strand displacement rate, which a maximum of 29-fold as acceleration acquired in inserting <sup>CNV</sup>K into center-position.

In chapter 5, I try to the photosplitting using branch migration with a 366 nm irradiation without heating. The sequence specific photosplitting using branch migration was advanced at room temperature without heating with a 366 nm photoirradiation.

In chapter 6, I demonstrated template directed reversible photochemical ligation of ODNs using carboxyvinylcarbazole (<sup>CV</sup>U). The template directed photochemical ligation of <sup>CV</sup>U advances with a 366 nm irradiation for 900s with high efficiency, and this photochemical ligation did not advance without a template and a change of alignment sequence by the sequence of the template Moreover I create a photoligated self-assembled DNA structure.

**Keyword** : 3-cyanovinylcarbazole nucleotide, DNA photocrosslinking, [2+2] photocyclization, DNA nanotechnology.