Micro-sized liquid crystals composed of short double-stranded DNA

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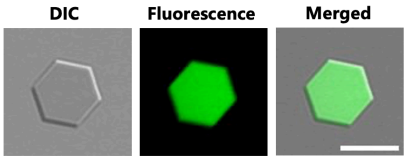
Crowded conditions can cause phase transition of biomolecules. For instance, the addition of high concentrations of polymers often causes double-stranded DNA (dsDNA) to liquid crystalline phase in aqueous-salt buffer solution. Recently, we have reported the formation of hexagonal DNA liquid crystals *via* assembly of one pair of short dsDNA in aqueous-salt poly(ethylene glycol) (PEG) solution.[1] Independent micro-sized hexagonal assemblies have been easily observed by confocal laser scanning microscopy (Figure 1).

Each DNA strand possesses a complementary overhang to promote stacking between the short dsDNAs in the liquid crystalline phase through hydrogen bonding of base pairs. Polarization microscopy observations strongly suggested parallel alignments of short dsDNAs in the condensed hexagonal assembly. The formation of hexagonal DNA assembly was highly dependent on the sequences and concentrations of DNA and PEG in the solution.

On the other hand, the electrical conductivity of dsDNA has been under investigation for decades. Our group have investigated the properties of DNA-mediated electron transfer in cholesteric liquid crystalline DNA using a syntheseized oligonucleotide.[2] The DNA-mediated electron transfer efficiency was highly promoted in a cholesteric liquid crystalline phase. The phase transition between cholesteric and columnar hexagonal phases readily occurs due to changes in the twisting of packed dsDNA. These self-assembled forms of DNA liquid crystals could have great potential for future biomedical device development.



5′- AATGTGATTAAGGGTATTTAGATTT- 3′
3′-AATTACACTAATTCCCATAAATCTA - 5′

Figure 1 Differential interference contrast (DIC), fluorescence, and merged images of a typical hexagonal assembly and the DNA sequence for a building block. Scale bar: 10 μm.

References

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[2] Taketomi, Y.; Yamaguchi, Y.; Sakurai, S.; Tanaka, M., *Org. Biomol. Chem.*, **2022**, *20,* 2043-2047.

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