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Fabrication of DNA-mimetics as Two-dimensional Hyper-structured Molecular Assemblies

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DNA is a double helical hyperstructured molecular assembly composed of complementary basepairs between adenine-thymine and guanine-cytosine. We have already reported that the nucleobase amphiphiles formed basepair and base trimer at the air-water interface[1-4], which were similar to the structure of natural DNA duplex and triplex. To confirm the sequenced molecular arrangement transcribed by the template oligonucleotides added in the subphase, a polymerizable group is introduced into the alkyl chain of the adenine and thymine amphiphiles (DA-Ade, DA-Thy). Diacetylene group is chosen as a polymerizable spectral probe because of its photopolymerization with remarkable color change. Ternary mixtures of DA-Ade, DA-Thy, and C_{18}-Cyt were spread on aqueous subphases containing oligonucleotide, $d(GT)_{15}$ or $d(GGT)_{10}$. The non-polymerizable cytosine amphiphile is expected to be squeezed into the one-dimensional diacetylene arrays to suppress the polymerization.

The monolayer formed on dT_{30} solution shows "blue form" of polydiacetylene with absorption maximum at 638nm, which is identical with that of the polymerized DA-Ade/DA-Thy monolayer without C_{18}-Cyt. The A-T base pair interacted with dT_{30} in the subphase and isolated C_{18}-Cyt amphiphiles from the mixed monolayer. On the contrary the photopolymerization of the 1:1:1 mixture spread on the $d(GT)_{15}$ subphase was suppressed and the spectral shift to 633nm was observed. Drastic suppression of polymerization was found when the 1:1:2 mixture was spread on the $d(GGT)_{10}$ subphase. It is suggested that the DA-Ade/DA-Thy base pair and C_{18}-Cyt can recognize dT and dG in the oligonucleotides, respectively. Owing to the inter-chain polymerization the complete suppression of the diacetylene photopolymerization was not achieved in this study. Complete isolation of the single oligonucleotide chain complexed with the ternary mixed monolayer is required to the complete suppression of the polymerization.

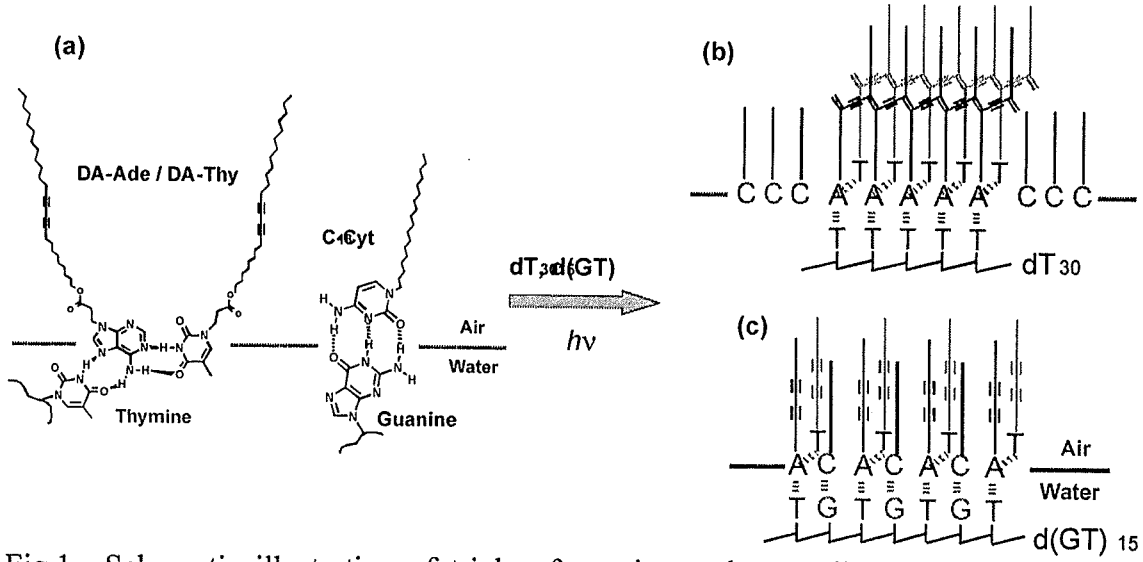

Fig.1 Schematic illustration of triplex formation and controlled photopolymerization of the mixed monolayer arranged by oligonucleotide templates.

References

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