ELECTRIC FIELD EFFECTS ON THE SELF-ASSEMBLY AND HYBRIDIZATION OF FUNCTIONALIZED OLIGONUCLEOTIDES

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DNA and DNA hybridization is increasingly being employed in the fabrication of 2D and 3D self-assembled films of potential applicability. However, to exploit fully and meaningfully the potential technological innovations these systems offer it is necessary to improve the presently available methods for DNA film preparations and hybridizations. We report here the electric field effect on the self-assembly of functionalized oligonucleotide (single stranded short chain DNA, ssDNA) films and their hybridized counterparts (double stranded short chain DNA, dsDNA). Two relatively simple complimentary pairs of thiol functionalized oligonucleotides, O12 - OC12, and O25 - OC25, (containing 12, and 25 base units, respectively) was selected for self-assembly onto gold substrates; electric field was applied during the self-assembly and/or hybridization to align the functionalized DNA perpendicularly to the substrate; the characterization of ss DNAs and dsDNAs on gold substrates was done by the means of combined electrochemical and spectroscopic measurements.

The detection of a submonolayer of label-free thiol-functionalized oligonucleotides on gold film is experimentally demanding.[1] However, as it is shown in Figure 1., Polarization Modulation Infrared Reflection Absorption Spectroscopy (PM-IRRAS) is a suitable method for qualitative, and (with careful calculations) quantitative analysis of submonolayer thick ssDNA and dsDNA films. The characteristic deoxyribose peak (~1100 cm^{-1}) is well distinguished for ssDNA and dsDNA films and the hydrogen-bonding of two strands manifests itself in high absorption around 1650 cm^{-1} [2] and thus PM-IRRAS provides a convenient mean for monitoring the process of hybridization. The effect of electric field on the density and order of the oligonucleotide films will be discussed.

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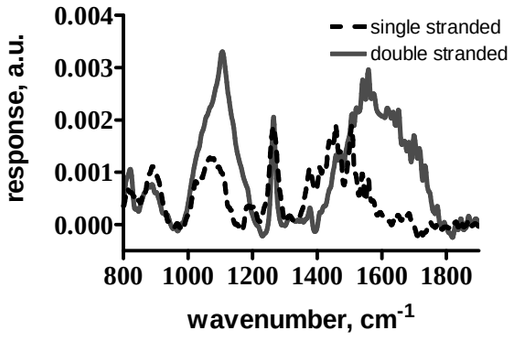

Figure 1. PM-IRRAS (grazing angle external reflection) spectra of thiol-functionalized submonolayer of a ssDNA and a dsDNA on Au surface which is formed by in situ hybridization by its complementary ssDNA.

References

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