

NIRT grant 0103034:

Zeolitic Materials for Nanoscale Electronics & Quantum Computation

Highlight: synthesis of ordered DNA, electrostatic manipulation of DNA, charge transport through DNA.

Double-stranded deoxyribonucleic acid (DSDNA) forms a candidate for nanoscale interconnects adaptable to nanoelectronics. This project contributes to investigations of the electronic conductivity of DSDNA, with the aim of forming Ohmic electrical connections to individual atomic chains in zeolitic crystals. Ordered sequences of base pairs (bp) lead to more reproducible and definite experimental results and have therefore been employed in this study. Figure 1 (main panel) contains capillary electrophoresis data (monitored by laser-induced fluorescence) of a mixture of varying lengths of ligated poly-AT DSDNA, and illustrates the synthesis of up to 210 bp poly-AT strands. The right insert in Figure 1 illustrates the electrostatically induced migration of DSDNA, observed by fluorescence confocal microscopy. Under the influence of the electric field, the DSDNA (dye-intercalated λ -phage DNA of length 16.5 μm) has migrated toward an electrostatically biased lithographic Au electrode fabricated on a GaAs semiconductor substrate. Electronic conductivity measurements have been conducted on ordered DSDNA, utilizing the electrode geometry in the left inset of Figure 1. The Au electrodes were defined by electron beam lithography on a thermal SiO_2 layer on Si substrate. The 190 nm long DSDNA consisted of 561 bp of the D1S80 strand (of 16 base pair repeat unit). Thiol end-groups were appended to the DSDNA, providing attachment points to the Au electrodes, and electrodes were bridged by the electrostatic alignment of multiple strands. Preliminary measurements indicate the presence of finite electrical resistance ($\sim 5 \text{ M}\Omega$), attesting to the suitability of ordered DNA for nano-interconnects.

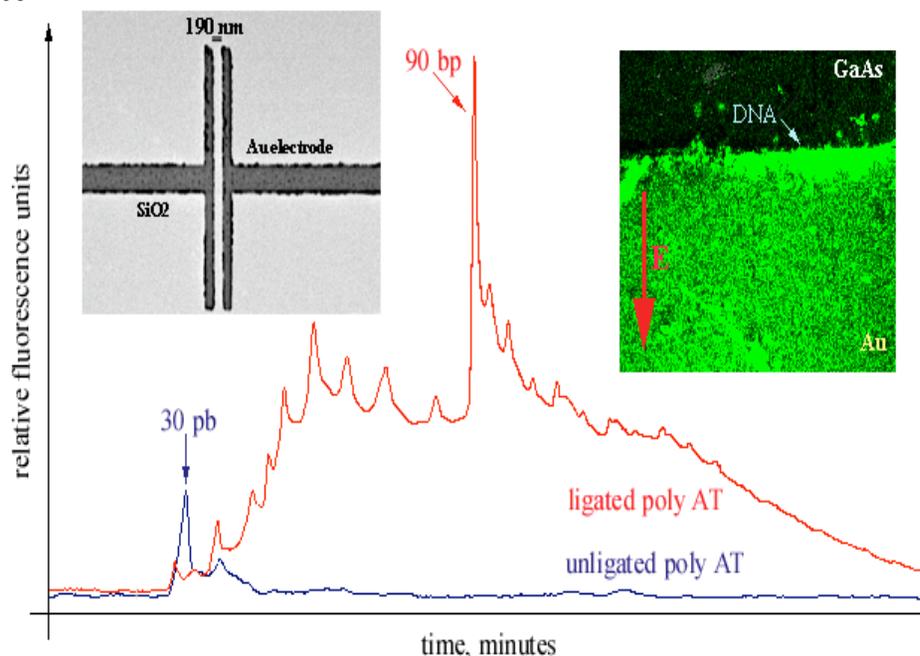


Figure 1

Relevance to nanoscience: Ordered DSDNA is under investigation for its role as a nanoscale electrical interconnect, with particular emphasis on DSDNA synthesis, manipulation and electrical conductivity.

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