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Sublithographic-Scale Nanowire Array for Long DNA Manipulation and Separation

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Electrode-embedded nanopore (EN) which is the next generation DNA sequencing provides us to know the sequence of nucleotide by the transverse electron tunneling current measurement during DNA pass through. Nanostructure electrophoresis is promising to elongate the DNA molecule before translocation at nanopore, particularly nanopillar array chip. According to the theoretical work for the effective of DNA elongation, the pillar size should be similar with the Kuhn length; however it is still difficult to fabricate the nanopillar with high aspect ratio. Here we demonstrated the elongation of DNA by bottom up approach self-assembly oxide nanowire embedded in microfluidic chip on a fused silica substrate (figure1) to elongate a single long T4-DNA and also separate the mixture of DNA molecules. Remarkably, the single T4-DNA can be kept its linear shape after hooked with nanowire array and elongated (figure 2a). Moreover, spot array nanowire chip could separate 1 kbp and T4 DNA under DC electric field within 30 s (figures 2b). The spatial controllability of sublithographic-scale nanowires within microchannels offers a flexible platform not only for manipulating and separating DNA molecules but also for integrating with other nanostructures to detect biomolecules such as nanopore sequencing.

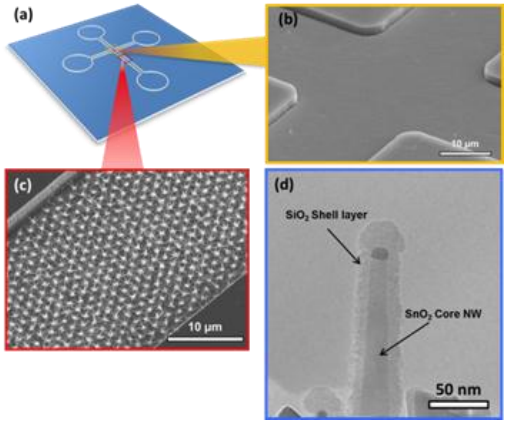

Fig 1.(a) Schematic of nanowires DNA chip. (b) SEM image of microchannel. (c) SEM image of nanowire arrays in microchannel and (d) TEM image of core-shell nanowire structure.

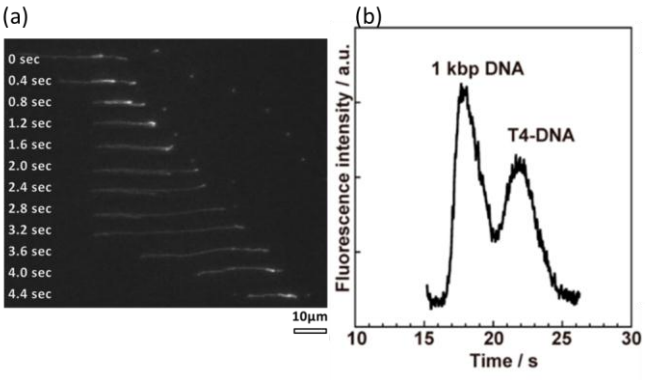

Fig 2.(a) Series of frames show the unhooking of T4 DNA in nanowires chip under DC electric field 10 V/cm. (b) Electropherogram of 1kbp and T4 DNA separation in nanowires array chip under 55 V/cm.

Reference

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