ソリッドナノポアによる アルカリ CsCl 溶液下での１本鎖 DNA ホモポリマの４種塩基識別

Identification of four-nucleotide single-stranded DNA homopolymers with a solid-state nanopore in alkaline CsCl solution

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DNA sequencing via solid-state nanopore is a promising technology with the potential to surpass the performance of conventional sequencers. However, the identification of all four nucleotides with a typical SiN nanopore has yet to be clearly demonstrated because a guanine homopolymer rapidly forms a G-quadruplex in a typical KCl aqueous solution. To address this issue, we introduced an alkaline CsCl aqueous solution, which denatures the G-quadruplex to a single-stranded structure by disrupting the hydrogen-bonding network between the guanines. Using this alkaline CsCl solution, we provided a proof of principle that single-stranded DNA homopolymers of all four nucleotides could be statistically identified according to their blockade currents with the same single nanopore. We also confirmed that a triblock DNA copolymer of three nucleotides exhibited a trimodal Gaussian distribution whose peaks correspond to those of the DNA homopolymers. Our findings will open the door to achieving solid-state nanopore sequencing.

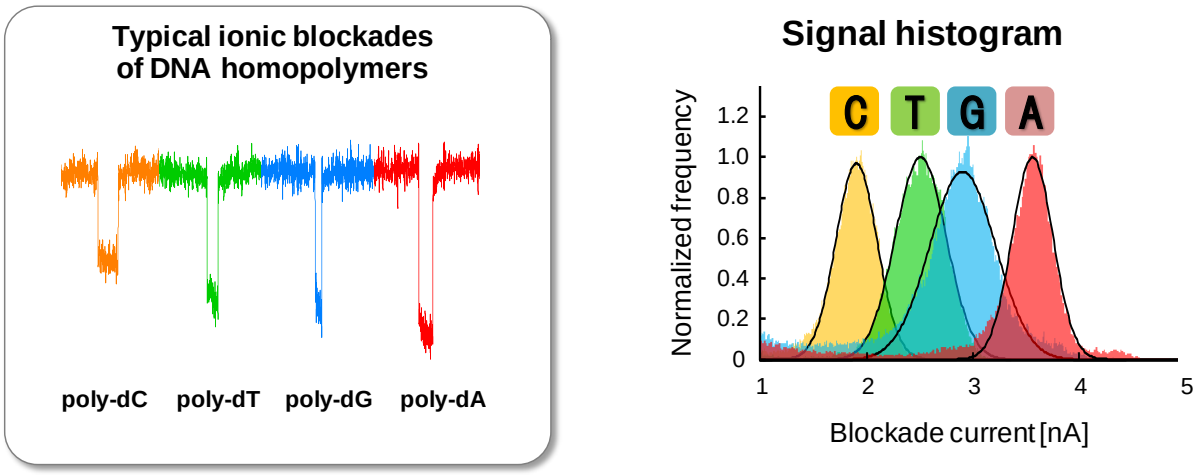

Figure 1. Discrimination of four kinds of nucleotides. (Left) Typical translocation event of each DNA homopolymer of the ionic current showing DNA translocations for a single nanopore (3.2 nm) with poly(dC)$_{60}$ (yellow), poly(dT)$_{60}$ (green), poly(dG)$_{20}$ (blue), poly(dA)$_{45}$ (red). (Right) All-points blockade current histograms from the nanopore shown in (Left) for (a) poly(dC)$_{60}$ (yellow), poly(dT)$_{60}$ (green), poly(dG)$_{20}$ (blue), poly(dA)$_{45}$. All histograms shown in (a) exhibits a single gaussian distribution.