Slowing down DNA translocation using magnetic and optical tweezers

HONGBO PENG, SHANSHAN WU, SANG RYUL PARK, ANDREW POTTER, X. S. LING, Brown University — Electric-field driven DNA translocation through nanopores can be exploited for DNA sequencing and other applications. However, the DNA translocation under normal patch-clamp-type measurement is too fast to allow detailed measurements of individual or few nucleotides. We propose a concept to slow down the DNA translocation through the nanopore by using magnetic (or optical) tweezers. The 3’ end of a single-strand DNA can be attached to a streptavidin-coated magnetic bead through a single biotin molecule. During DNA translocation, the 5’ end of DNA will be electrophoretically drawn through the nanopore to the trans side while the 3’ end of DNA stays in the cis side with the magnetic bead. A set of permanent magnets or electric coils can be used to generate a magnetic field gradient large enough to pull the bead, hence the DNA out of the nanopore. The net force on the magnetic bead will determine this back-translocation speed. By carefully tuning the magnetic field gradient and the voltage bias on the nanopore, one can make the back-translocation much slower than the conventional forward-translocation in which case the DNA is driven only by the electric force. We will report our experimental design as well as the preliminary results.

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Xinsheng Ling
Brown University

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