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Single Molecule Electrical Sequencing of DNA and RNA

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Gating nanopore devices are composed of nanopores with embedded nanoelectrodes, and they are expected to be one of the core devices used to realize label-free, low-cost DNA sequencing, subsequently leading to $1000-genome sequencing technologies. The operating principle of these nanodevices is based on identifying single base molecules of single DNA passing through a nanopore using a tunneling current between nanoelectrodes. We successfully identified single base molecules of DNA and RNA using tunneling currents. To make gating nanopore devices fit for practical use, core technologies should be integrated on one device chip. One core technology is the identification of single DNA and RNA composed of many base molecules using tunneling currents. We have succeeded in the single-molecule electrical sequencing of DNA and RNA formed by 3 and 7 base molecules, respectively, using a hybrid method of identifying single base molecules via a tunnelling current and random sequencing. A method that controls the speed of a single DNA passing through a nanopore is one core technology that determines the speed and accuracy of sequencing. We successfully developed a method that controls the translocation speed of a single DNA by three orders of magnitude using a voltage between nanoelectrodes.