Nanopores in photonic waveguides

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Solid-state(SS) nanopore (NP) sensing of DNA currently faces several challenges, one of the major challenges is the speed at which signals can be measured while maintaining high enough accuracy for differentiation[1,2]. However due to rapid translocation time, approximately one to several microseconds[2,3], it's hard to achieve high resolution nor high throughput. This is especially true for electrical NP sensing, which is limited to ~10-100 kHz sensing[4], because of the increased noise at higher frequencies. Optical sensing circumvents this since it has a "flat" noise spectrum which is as good as frequency independent. The optical technique that most of the scientific community is looking at are Zero-mode waveguides (ZMWs). Nonetheless ZMWs have their own challenges and limitations. Therefor we present a novel technique, nanopores in photonic waveguides, which circumvents several challenges. This novel technique can have much higher reading speeds than ZMWs as it doesn't need to use a CCD while multiplexing. This is because this new technique doesn't need to record spatial information in comparison to ZMWs arrays. Therefor weaker signals can be detected then when using a CCD. Furthermore, this novel technique can excite in a much precise way than is possible in ZMWs. This results in higher light intensities at the NP and a greater reduction in background noise. Initial simulations have shown that reading speeds of one to a few MHz are achievable. This would allow to read DNA at nominal translocation times without the need of complex schemes to reduce the translocation time. When necessary the translocation time can be controlled by adjusting the transmembrane voltage as the signal is independent of the voltage. Simulations have been done using 50 nm NPs and have shown decent results, smaller NPs would only benefit the excitation and collection efficiencies.

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