Single-molecule Surface-enhanced Raman Spectroscopy on Plasmonic Nanopores

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Raman spectroscopy can provide molecular fingerprints by detecting the energy shift of photons that have inelastically scattered from molecules. By combining Raman spectroscopy with solid-state nanopores, it is possible to identify the species and chemical states of the analytes during their translocating through the nanopore. However, the Raman signal is typically much weaker than the Rayleigh/elastic scattering, making it impractical to directly acquire Raman spectra from single molecules in solid-state nanopores without any amplification. Here, we demonstrate a method to amplify Raman signals from translocating molecules by integrating a solid-state nanopore with plasmonic nanostructures. These plasmonic nanoantennas can significantly enhance and the localize the electromagnetic field, boosting the Raman signals at least by a factor of 10^8. Such extreme signal enhancement opens up the possibility of chemical detection of single molecules in a nanopore.
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References

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