Single-molecule detection of biomolecules using engineered nanopores

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A nanopore may act as an amazingly versatile single-molecule probe that can be employed to reveal several important physical and chemical features of biomolecules, such as nucleic acids and proteins. The underlying principle of nanopore probe techniques is simple: the application of a voltage bias across an electrically insulated membrane enables the measurement of a tiny picoamp-scale transmembrane current through a single hole of nanometer size, called a nanopore. Each molecule, translocating through the nanopore, produces a distinctive current blockade, the nature of which depends on its physical properties of the translocating molecules as well as the molecule-nanopore interaction.

Such an approach proves to be quite powerful, because single small molecules and biopolymers are examined at very high spatial and temporal resolutions. This project will envolve recent developments in molecular genetic engineering, single-molecule biophysics and nanotechnology. The long-term goal of the project is designing hybrid nanofluidic devices that include protein and synthetic nanopores.

From a practical point of view, this methodology shows promise for the integration of engineered nanopores into portable instruments, which would provide a new generation of research tools in nanomedicine and high-throughput devices for molecular biomedical diagnostics.