Detection, Characterization, & Identification of Single Molecules Using Nanometer-Scale Pores

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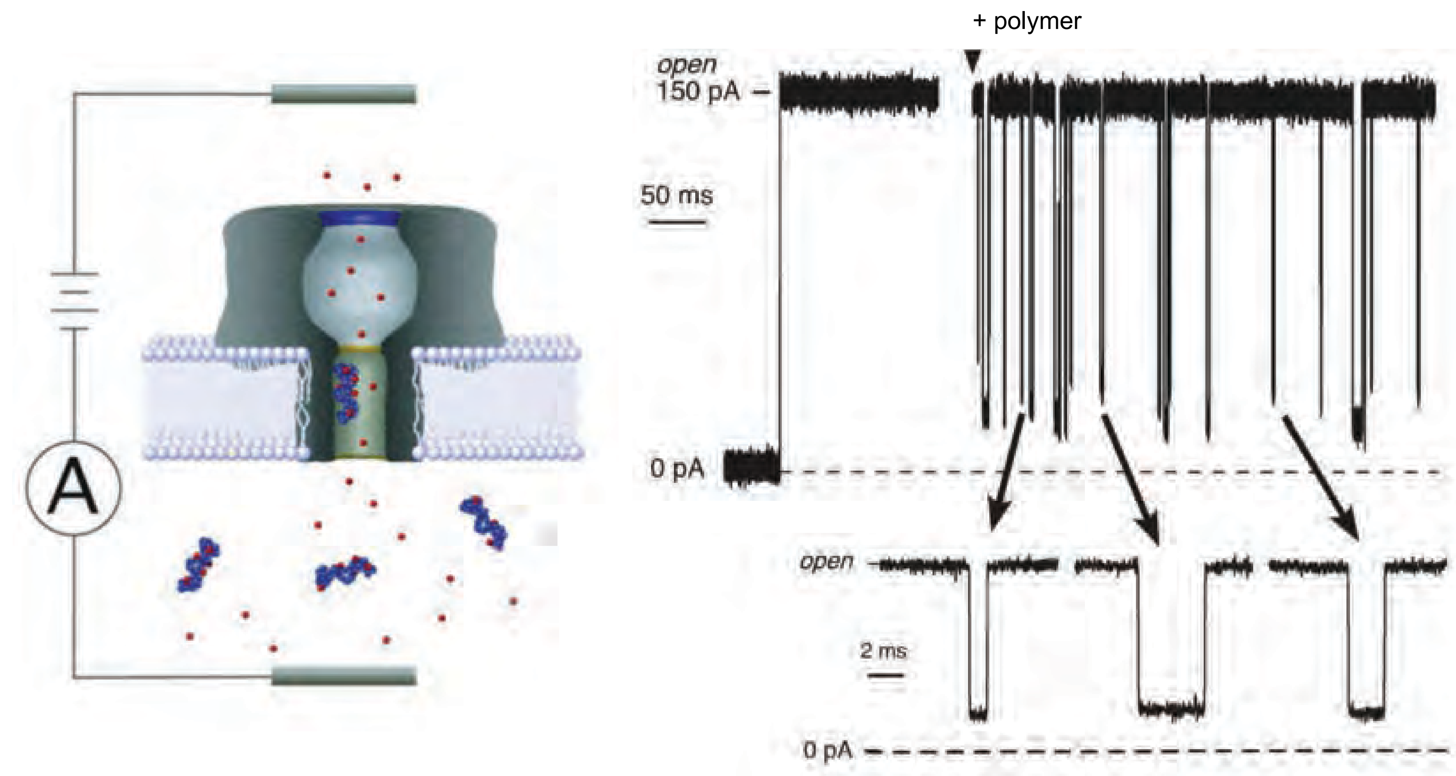

Fig. 1. Detection of individual molecules with a nanometer-scale pore. The flow of electrolytes through the pore is reduced by a single polymer.

Qualifications & Capabilities

- *Polymer physics:* Our team has expertise in polymer physics using both traditional and unique instrumental methods including light and neutron scattering.
- Nanopore spectroscopy: We demonstrated the use of single nanometer-scale pores to identify and characterize individual polymers at high resolution.
- *Chemical synthesis:* Traditional and unusual chemical synthesis (including radiation induced polymerization) are used, offering exquisite control over polymeric properties.
- *Dimensional metrology standards:* We collaborate with others who develop standards for measuring length in solid and dynamic materials. These tools will afford cutting-edge data density measurements.

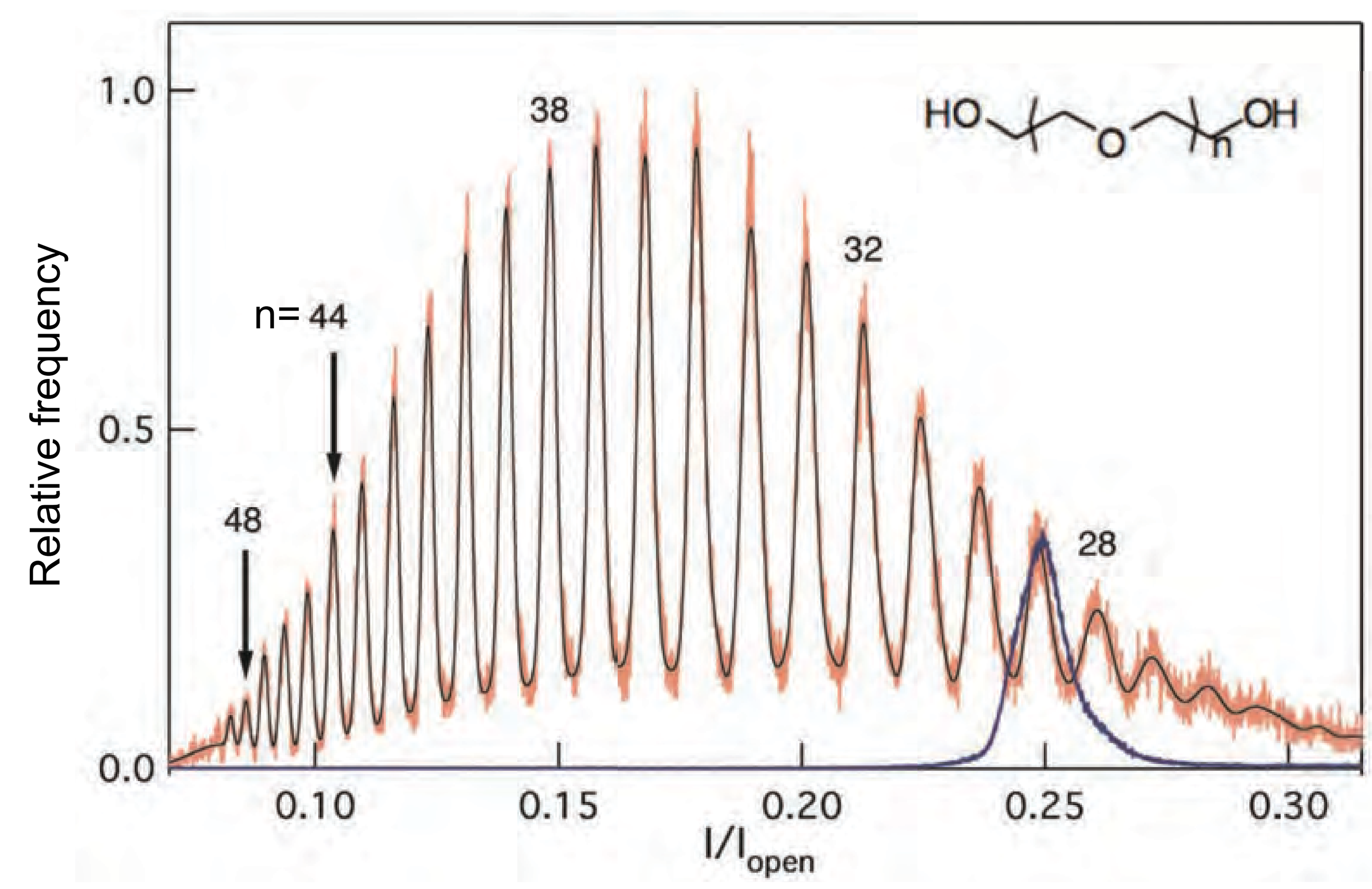

Fig. 2. Nanopore spectroscopy discriminates among polymers in a mixture based on size (*volume exclusion*) and chemistry (*adsorption of electrolyte*). Each peak in the pore ionic conductance histogram (*pink*) corresponds to a particular molecular weight with resolution is better than a single monomer. This type of mass spectrum is calibrated with a nearly monodisperse polymer (*blue*).

Robertson, J.W.F., et al. 2007. 2007. *PNAS* **104**, 8207; Reiner, J.E., et al. 2010. *PNAS* **107**, 12080.

Capabilities we seek

- Expertise in *computer design* for integration into information systems.
- *Information theory* for the development of robust memory encoding schemes.

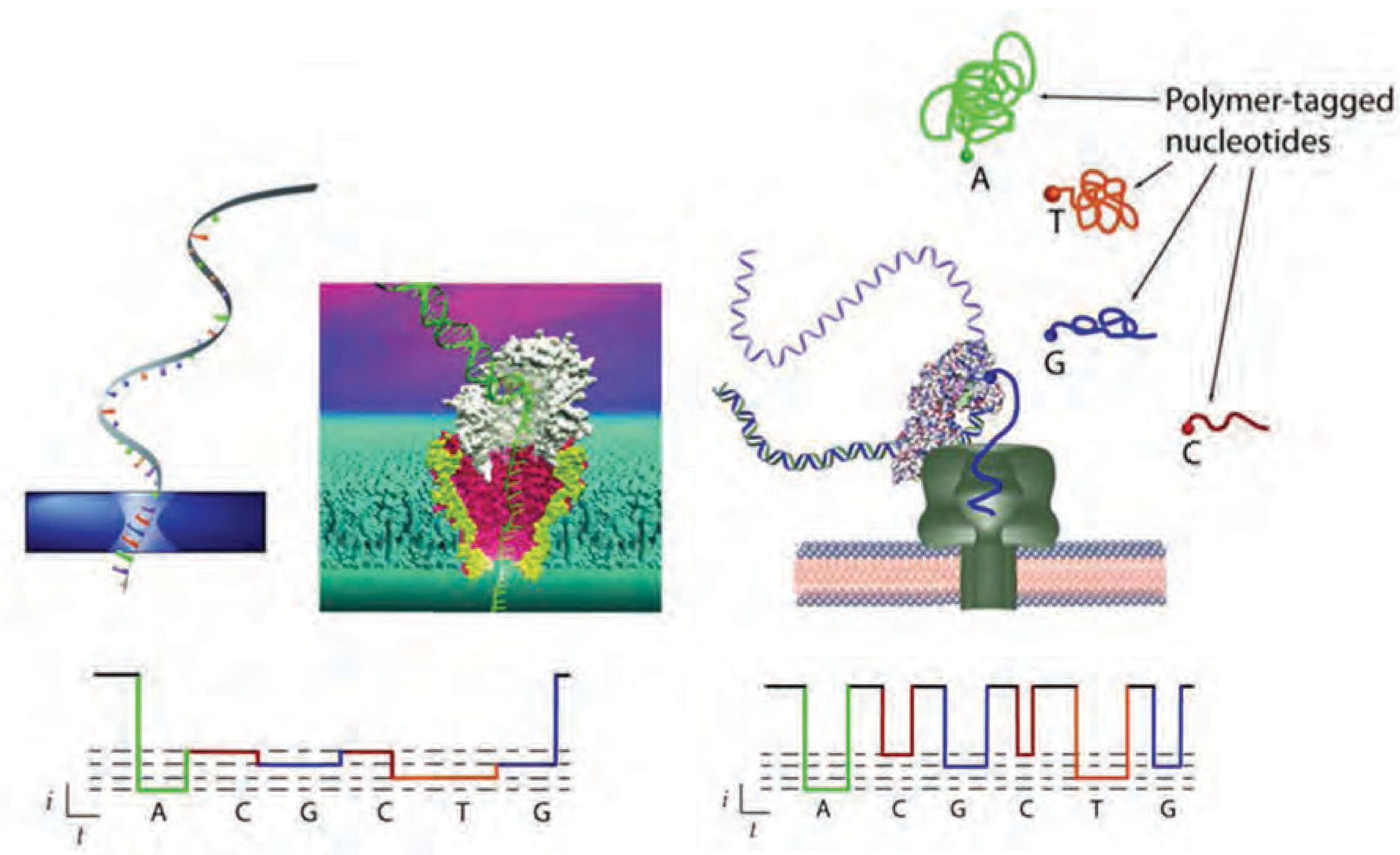

Fig. 3. Novel DNA sequencing methods are based on the ability of a nanopore to discriminate between different bases in a polynucleotide (*left*) or different polymers that uniquely correspond to the four different bases (*right*).

Kasianowicz, J.J., et al. 1996. *PNAS* **93,** 13770; Kumar et al. 2012. *Sci. Reports* **2**, 684; Reiner, et al. 2012. *Chem. Rev.* **112**, 6431.

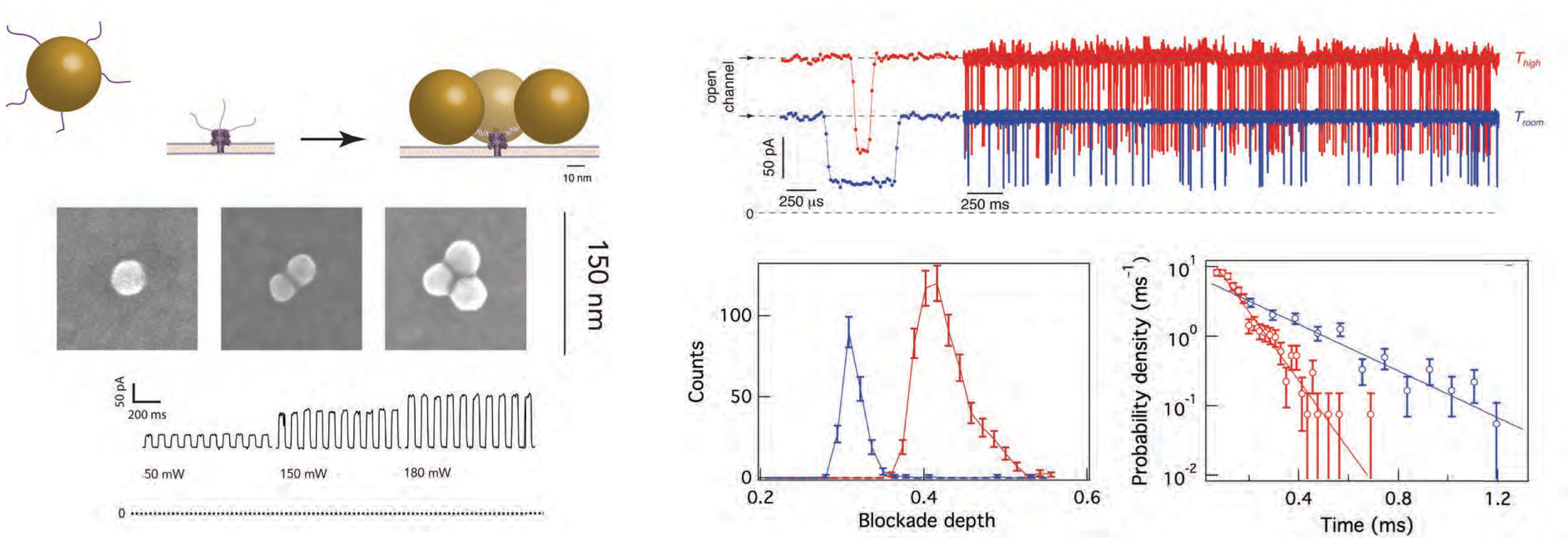

Fig. 4. Single molecule thermodynamics. The fluid inside a single nanopore can be rapidly changed by illuminating gold particles attached to the pore with visible light (*top left*). SEM images of typical Au clusters (*middle left*). The pore ionic conductance scales with the local temperature (*bottom left*). The degree by which individual polymers reduce the pore conductance and the residence time of the polymers in the pore are altered by the temperature of the aqueous solution in the pore (*right*).

Reiner, J. E., et al. 2013. *JACS* **135**, 3087.