Nanopore Protein Sensing Using Induced Reverse Electroosmotic Flow

Wei-Lun Hsu, and Hirofumi Daiguji

Department of Mechanical Engineering, University of Tokyo, Tokyo 113-8656, Japan

The control of biomolecule translocation through nanopores is important in nanopore protein detection. Improvement in current nanopore molecule control is desired to enhance capture rates, extend translocation times, and ensure the effective detection of various proteins in the same solutions. We present a method that simultaneously resolves these issues through the use of a gate-modulated conical nanopore coupled with solutions of varying salt concentration. Simulation results show that the presence of an induced reverse electroosmotic flow (IREOF) [1] results in inlet flows from the two ends of the nanopore centerline entering into the nanopore in opposite directions, which simultaneously elevates the capture rate and immobilizes the protein in the nanopore, thus enabling steady current blockage measurements for a range of proteins. In addition, it is shown that proteins with different size/charge ratios can be trapped by a gate modulation intensified flow field at a similar location in the nanopore in the same solution conditions.

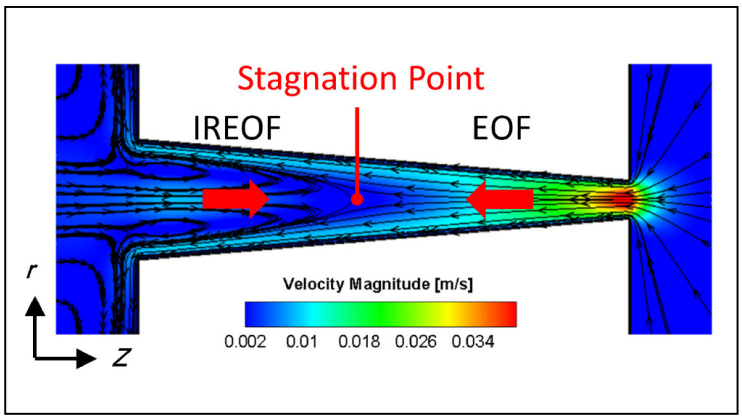

Fig. 1: Flow field in a negatively charged conical nanopore located between two large reservoirs carrying different salt concentrations when an axial electric field is imposed. Electroosmotic flow (EOF) induces a reverse flow resulting in a stagnation point appearing in the nanopore.

[1] W.-L. Hsu, and H. Daiguji, *Anal. Chem.* **88(18)**, 9251-9258 (2016).