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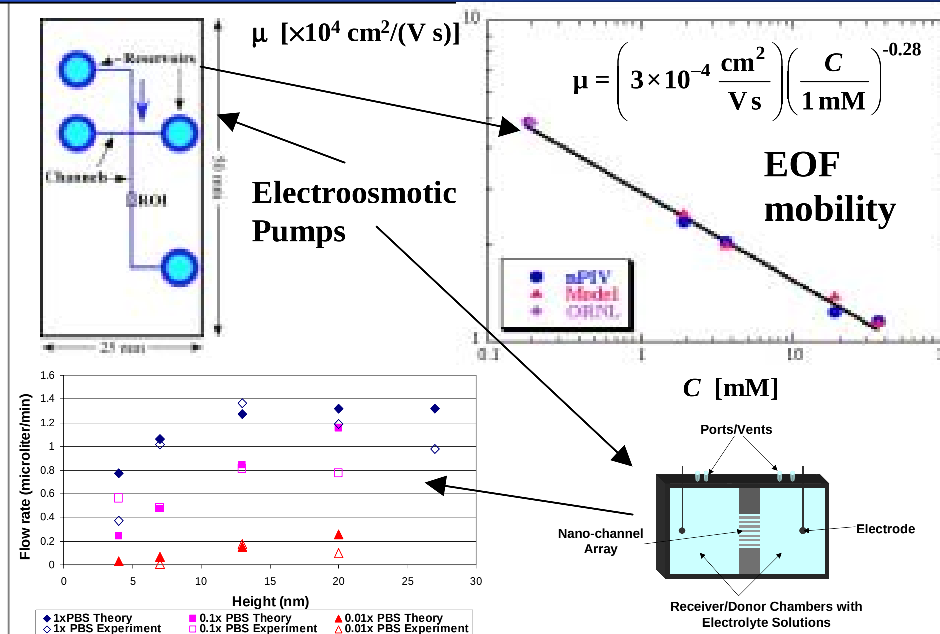
Goals and Potential Impact if Successful

- Develop PDE models to predict the velocity profile, flow rate of biofluids through nanopore membranes.
- Develop scaling laws to enable microscale experiments to address nanoscale transport.
- Predict transport of proteins through nanoscale membranes.
- Understand and predict flow effects in unsteady and transient EOF in nanochannels for biomolecular sensing.
- Impact: cut design time of nanoscale devices significantly.
- Reduce the number of protoype devices required.
- Applications: electroosmotic pumps, drug delivery, biomolecular sensing.



Recent Accomplishments

- Believed to be first published comparisons of model with experiment at nanoscale (Conlisk *et al* AC 2002, Zheng *et al* Electrophoresis, 2003; iMEDD, ORNL).
- Comparison w/iMEDD synthetic ion channel data for glucose and albumin transport very good.
- Tech Transfer: will soon provide iMEDD with suite of EOF programs.
- Completed model for three dimensional flow in 2D confined nanochannels.
- Comparison of model with GTech experimental data extremely good(Sadr *et al* J. Fluid Mech, 2004).
- Summary: Models for ionic and biomolecular transport compare well with four distinct sets of experimental data comprising over 15 operating conditions at micro and nanoscale.

Bottlenecks and Open Research Questions

- Characterization of surface properties including roughness and charge at nanoscale.
- Properties of biomolecules especially proteins are not well understood. Models need size, net charge, conformation and other properties.
- This information must come from someone with chemistry/biology background.
- Engineers must interface with biologists and chemists routinely. Need a common language base.
- Is there new physics at nanoscale?
- What is the character of the temperature distribution?
- At what dimension does the continuum approximation break down?
- Experimental methods cannot currently address the nanoscale which makes modeling essential.