NANO HIGHLIGHT
Active Membrane Pumps for Bio-Pharmaceutical Separations

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One of the key tools of the biotechnology revolution is the ability to genetically modify a microbial or plant organism to produce complex human proteins and enzymes for bio-pharmaceuticals. However, a key difficulty is that an organism produces hundreds of thousands of other proteins to function making separation of the desired proteins the most expensive step. 80% of the $50,000 per year drug cost for biomolecule treatments is associated with separation. Nature is able to separate complex proteins across fragile cell walls by remarkably selective binding and pumping cycles of protein transporters.

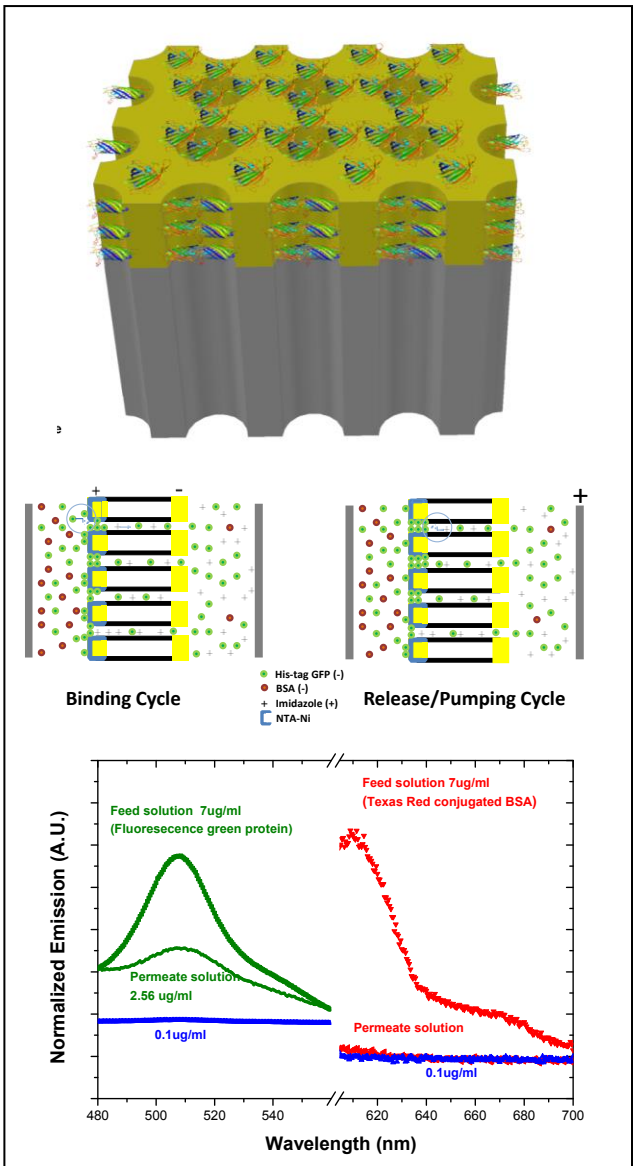

Figure A) Schematic of biomimetic protein pump with target protein selectively bound at pore entrance blocking the channels. B) Voltage pulse cycles for binding and release/pumping. C) Measured separations from test solutions.

Researchers here have been able to make a biomimetic protein pump system on a robust ceramic engineering membrane system. [1,2] It is based on nm-scale thick electrodes at the pore entrance that are able to attract desired proteins through an attractive voltage pulse and using selective surface chemistry. Importantly, this blocks the pore so that other unwanted proteins don't pass across the membrane. An opposite voltage pulse sends a protein release agent to the pore entrance and the oppositely charged protein is pumped across the membrane. An initial system with a membrane area of 0.75 cm^2 has the same throughput as 1ml of commercially available chromatography columns showing viability as a continuous process. This system will enable continuous separation of expressed proteins directly from fermentation broths, dramatically simplifying the separation process as well as reducing biopharmaceutical production costs.

References

[1] For further information about this project link to **http://faculty.washington.edu/bjhinds** or email **bjhinds@uw.edu**
[2] Z. Chen, X. Sun, T. Chen, B.J. Hinds *Adv. Funct. Mater.* **2014** DOI: 10.1002/adfm.201303707