ANALYTICAL CURRENTS

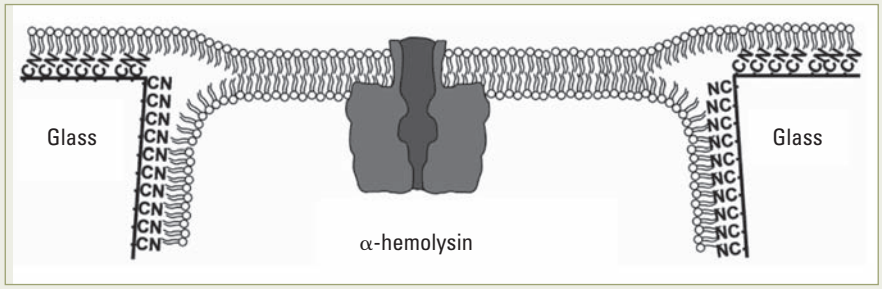
Glass nanopores for ion-channel recordings

Henry White, Paul Cremer, and their colleagues at the University of Utah and Texas A&M University have designed a glass nanopore (GNP) membrane support for single ion-channel recordings.

Typically, an ion channel is embedded in a planar lipid bilayer that is supported across an ~30–100 μm orifice in a hydrophobic polymer-based membrane. However, the larger the orifice, the more likely the lipid bilayer is to rupture, and the higher the overall system noise. The new GNP membrane support allows for orifices as small as 10 nm.

To fabricate their system, the researchers coated the interior and exterior surfaces of their GNPs with 3-cyanopropyldimethylchlorosilane. The hydrophobic tails of lipids interact favorably with the terminal –CN group of this molecule, and the lipids form a monolayer on the surface. At the pore opening, this monolayer merges to form a suspended bilayer.

To test their system, the investigators embedded α-hemolysin into a 100 nm GNP-suspended membrane and used it to detect the presence of the small molecule heptakis(6-*O*-sulfo)β-cyclodextrin. The researchers inserted the protein by using a novel method that applies a small pressure gradient across the lipid bilayers. They found that the small GNP pores performed as well as more traditional systems. The setup could withstand voltages of up to ~800 mV and was stable for at least 2 weeks at room temperature. (*J. Am. Chem. Soc.* **2007**, *129*, 11,766–11,775)



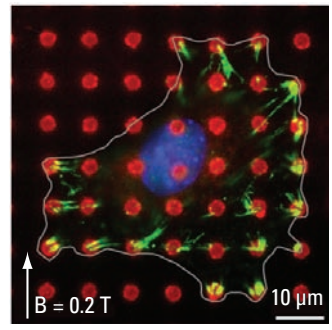
Schematic illustration of the suspended bilayer–α-hemolysin system at the GNP orifice.

Magnetic microposts apply mechanical forces on cells

To better understand how live cells react to external mechanical forces, Christopher Chen and colleagues at the University of Pennsylvania and Johns Hopkins University have created microfabricated arrays of magnetic and nonmagnetic posts.

Various cellular structures can convert mechanical forces into biochemical signals. Among them are focal adhesions—clusters of membrane proteins that attach to the extracellular matrix—which play a key role in detecting external and internal forces. However, it's not obvious whether external forces act directly on cells or depend on mechanically induced changes in traction forces inside the cell.

Chen and colleagues designed the arrays of magnetic and nonmagnetic PDMS posts so that they could apply external forces and observe changes in traction forces in live cells simultaneously. A handful of microposts contained magnetic nanowires. In a magnetic field, the nanowire-embedded posts applied small forces to individual focal adhesions in cells cultured on the tops of the posts. Nonmagnetic posts acted as simple springs and deflected in response to traction forces inside the cells.



An immunofluorescence micrograph shows focal adhesions (green), microposts (red), and cell nucleus (blue) after force actuation. The direction and magnitude of the magnetic field are indicated. (Adapted with permission. Copyright 2007 National Academy of Sciences, U.S.A.)

When the investigators compared forced and unforced points of cells, they discovered that focal adhesions grew larger at the magnetic posts but not at the nonmagnetic ones. They also found that when the external force was applied, a widespread, but not uniform, loss took place in traction forces across the cell. Most of the loss occurred at the cell edges. Chen and colleagues say their data suggest that cells actively modify their internal tension in response to external mechanical forces, and the work highlights the need to characterize mechanical feedback in cells. (*Proc. Natl. Acad. Sci. U.S.A.* **2007**, *104*, 14,553–14,558)