ANALYTICAL CURRENTS

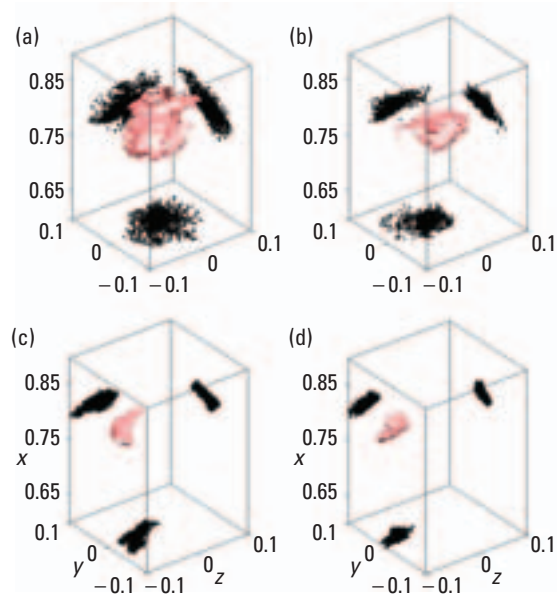
Dynamics of cell growth observed in an optical trap

Live cells grow and change even while they are being studied. How does that affect analyses of them? To find out, Dmitri Petrov and colleagues at the Institute of Photonic Sciences and the Catalonian Institute for Research and Advanced Studies (both in Spain) have analyzed the dynamics of the forward-scattered light from individual cells in optical traps.

Petrov and colleagues measured the spatial distribution of the forward-scattered light from trapped particles with a quadrant photodiode. The sum (z) and differential (x and y) signals of the photodiode were monitored so that 3D images of a particle's position could be constructed.

Individual live yeast cells were studied for 45–60 min. During the first 10–12 min, the distribution of the scattered light shrank and became concentrated around the optical axis of the experimental system. Petrov and colleagues interpreted this change as the rearrangement of organelles inside the cell in response to the applied optical force. When the yeast cell started to form a bud, the direction of the scattered light moved off the optical axis. The investigators suggested that the conformational changes in the budding cell affected its equilibrium position and changed the direction of the scattered light.

The investigators pointed out that a cell's growth could cause changes in its equilibrium position during the analysis; these changes must be taken into account when the data are interpreted. When cells don't appreciably alter their shapes, changes in spectra can be attributed to biochemical processes occurring inside the cell. The variations could also be used to identify or sort cells in lab-on-chip devices. (*Appl. Phys. Lett.* **2006**, doi 10.1063/1.2213015)



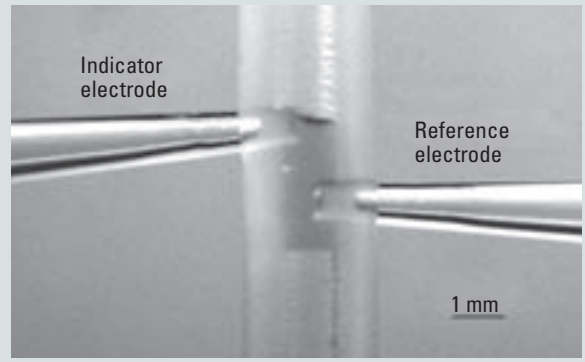
The distribution of forward-scattered light by a budding yeast cell at (a) 6, (b) 10, (c) 30, and (d) 45 min in the optical trap. The sum (z) and differential (x and y) signals are plotted, and in all cases the units are in volts. The acquisition time was 120 s with a 1000 Hz sampling frequency. (Adapted with permission. Copyright 2006 American Institute of Physics.)

Ion-selective electrodes with low detection limits

Adam Malon, Ernö Pretsch, and colleagues at the Swiss Federal Institute of Technology Zurich and Purdue University have developed a direct potentiometric sensor that can detect as little as 300 attomoles of ions in 3 µL of solution.

The researchers attached ion-selective membranes selective for Ca^{2+}, Pb^{2+}, and Ag^{+} to conventional polypropylene micropipette tips and used 100-mL sequential dilutions of ions in sodium nitrate buffer to calibrate the electrodes. The electrodes had detection limits of 1.5 nM for Ca^{2+}, 2.7 nM for Pb^{2+}, and 3.4 nM for Ag^{+}. Malon, Pretsch, and colleagues then repeated the dilution experiments but inserted the electrodes into 3-µL volumes of ion solution separated by plugs of air within 1-mm-i.d. silicone tubing. These experiments yielded similar detection limits.

The researchers point out that these were conservative estimates because the results were based on the accepted IUPAC recommendations rather than the traditional definition of 3× the background noise level. When they used the latter definition, the scientists could detect 100-pM concentrations of ions (300 amol), and they extrapolated a potential detection limit of 0.98 zmol for silver. Thus, the scientists suggested that their data placed zero-current potentiometry among the most sensitive electrochemical methods available. (*J. Am. Chem. Soc.* **2006,** *128,* 8154–8155)



Attomoles of ions in samples as small as 3 µL could be detected with ion-selective membranes on micropipette tips.