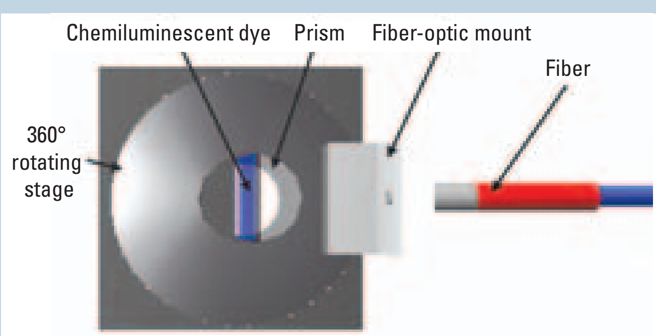
ANALYTICAL CURRENTS

Plasmon resonance boosts output of chemiluminescence

Chris D. Geddes and colleagues at the University of Maryland Biotechnology Institute and the University of Maryland School of Medicine have developed a method that couples surface plasmon resonance (SPR) to chemiluminescence signatures from a variety of thin metal coatings. The researchers suggest that this new combined imaging/sensing method, called surface plasmon-coupled chemiluminescence (SPCC), could increase the sensitivity of chemiluminescence-based assays. SPCC also appears to be capable of coupling many wavelengths of light across the visible spectrum, raising the possibility of using the technique in multiplexed assay formats.

To enhance the optical brightness and other photophysical properties of fluorescent dyes, Geddes and his colleagues have explored the interactions that can occur between excited plasmons and fluorescent molecules. The investigators now have extended their studies to molecules that undergo chemiluminescence. They found that chemically induced luminescent emissions can couple strongly with SPRs. When a chemiluminescent emission occurs within a few hundred nanometers of a thin metal surface, the metal coating emits highly polarized light that is much brighter and is highly directional when compared with the initial chemiluminescent signal.

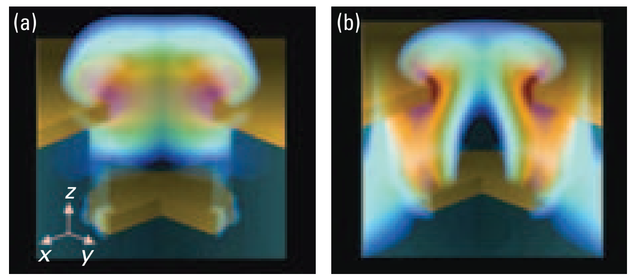
The wavelength of the SPCC-generated light matches the color of the chemiluminescent dye, and the SPCC emission occurs at an angle to the incident light that depends on the optical properties of the specific metal film. The researchers note that they observed strong SPCC emissions with gold, silver, and aluminum films with a variety of commercially available chemiluminescent dyes. (*J. Phys. Chem. B* **2006**, *110*, 22,644–22,651)



Top view of the experimental geometry and major components used for SPCC.

Biosensing and imaging on quasi-3D plasmonic crystals

A new class of quasi-3D plasmonic crystals has been developed by John Rogers, Ralph Nuzzo, and colleagues at the University of Illinois at Urbana–Champaign and Argonne National Laboratory. The crystals permit sensitive, quantitative detection and high-resolution imaging of molecular binding events. The fabrication cost is low, the readout apparatus is simple, and the crystals can be directly integrated into microfluidic networks.



(a) Computed electromagnetic field distribution associated with resonance at 883 nm shows that the intensity is concentrated at the edges of the nanoholes in the upper level of the crystal. (b) The distribution with resonance at 1138 nm displays strong coupling between the upper and lower levels of the crystal. (Adapted with permission. Copyright 2006 National Academy of Sciences, U.S.A.)

Unlike conventional surface plasmon resonance systems, this one doesn't use prisms to couple the light. Instead, the researchers created quasi-3D plasmonic crystals by an affordable technique called soft nanoimprint lithography. They fabricated large-area square arrays with cylindrical wells in polymer films and then uniformly deposited gold on the films. The result was quasi-3D plasmonic crystals that were arrays of nanoscale holes in gold films with physically separated gold disks at the bottoms of the wells.

The researchers showed that the optical transmission spectra of the crystals made them suitable for sensing. First, the investigators formed a monolayer of biotinylated bovine serum albumin (bBSA) on the array surface, and then they added avidin, which bound to the bBSA and yielded a large sensor response. Finally, free bBSA bound to the avidin; this response was smaller than that for the avidin.

The investigators next patterned a crystal with five lines of nonspecifically adsorbed fibrinogen and then imaged them in air. The spectral image showed five stripes with the expected geometries. Rogers, Nuzzo, and colleagues determined that the lines were ~7 nm thick, consistent with the molecular dimensions of fibrinogen. (*Proc. Natl. Acad. Sci. U.S.A.* **2006**, *103*, 17,143–17,148)