

### Chiral separations on chip

To facilitate the use of plastic microchips for applications such as proteomics, Baohong Liu and colleagues at Fudan University (People's Republic of China) modified the surface of PMMA microchannels with an alumina gel-derived protein network. The modified microchannels can encapsulate target biomolecules, such as bovine serum albumin (BSA); this makes them well suited for on-chip analysis of chiral interactions.

Liu and colleagues immobilized BSA in the modified microchannels to create a new protein stationary phase. They then used it to separate D- and L-tryptophan with electrochemical detection. The modified surface was more stable and hydrophilic than native PMMA microchannels and exhibited less nonspecific adsorption.

The general approach is not limited to the study of the interaction of an enantiomeric amino acid with BSA. According to the researchers, it could be used to study interactions with other biomolecules, such as antibodies, peptides, or whole cells. (*J. Proteome Res.* **2005**, doi 10.1021/pr050240j)

### QD-based DNA nanosensor

To detect specific DNA sequences without first performing an amplification step, Tza-Huei Wang and colleagues at Johns Hopkins University developed an ultrasensitive nanosensor that uses quantum dots (QDs) linked to DNA probes. The nanosensor can detect <50 copies of DNA and has much less background fluorescence than conventional fluorescence resonance energy transfer (FRET) systems.

The nanosensor includes two oligonucleotide probes that bind to separate regions of an assayed strand of DNA (target DNA). The reporter probe is labeled with a Cy5 fluorophore, and the capture probe is labeled with biotin. The probes bind the target DNA, and a streptavidin-coated QD binds to the capture probe. This process brings the Cy5 molecule close to the QD so that FRET can occur. Because QDs have broad absorption and narrow excitation spectra, the QD-based nanosensor system can be finely tuned so that background fluorescence is negligible. QDs also concentrate the FRET signal by binding many target-probe complexes.

To detect FRET signals, the researchers developed a novel confocal fluorescence microscopy platform. The QD-target-probe complexes were continuously flowed through a microcapillary past two detectors that were specific for signals from either FRET donors or acceptors.

When the system was tested with a single-stranded target DNA, fluorescence was observed with both detectors. However, when the target was absent or when a non-complementary DNA strand was used, only donor fluorescence was observed. Wang and colleagues also compared the performance of the QD nanosensor with that of a molecular beacon, which is typically used in FRET assays. The QD nanosensor was ~100× more sensitive.

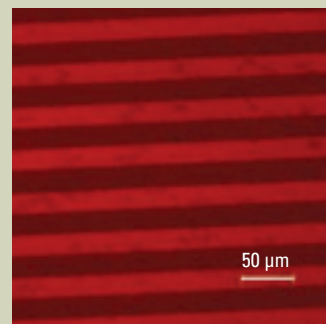
Finally, the researchers combined the nanosensor with an oligonucleotide ligation assay. This method allowed the discrimination of point mutations in DNA samples from ovarian cancer patients. According to the researchers, QD nanosensors could also be applied to non-DNA molecules, such as proteins. (*Nat. Mater.* **2005**, *4*, 826–831)

### Plasma-initiated micropatterning

Biomolecular micropatterns are used in numerous applications, including biosensors, DNA microarrays, and immunoassays. Although several micropatterning methods exist, they vary in terms of cost, ease of use, reproducibility, and applicability to specific ink-substrate combinations. To overcome some of the limitations of existing methods, including slow pattern formation, Kathryn Uhrich and Bryan Langowski of Rutgers University have developed a simplified technique that creates biomolecular micropatterns of varying complexity on organic, biocompatible polymer substrates. The method is cost-effective and reproducibly generates well-resolved microscale patterns in ~8 min.

In the new technique, which is called microscale plasma-initiated patterning, a patterned PDMS stamp is used to protect some areas of the substrate from oxygen plasma while allowing other areas to be exposed. As a result, distinct microscale domains with different hydrophilicities are formed on the substrate. The different regions exhibit varying affinities for a given biomolecule.

The researchers evaluated several inks, including goat anti-rabbit immunoglobulin G, poly-L-lysine, and bovine serum albumin (BSA). Protein patterns of BSA were stable after 4 weeks of incubation at 37 °C. (*Langmuir* **2005**, *21*, 10,509–10,514)



Fluorescent micrograph of a simple protein pattern of BSA on PDMS generated by plasma-initiated micropatterning.