taking place during a catalytic reaction is still a significant challenge. Now, Bert Weckhuysen, Frank de Groot and colleagues at Utrecht University, Delft University of Technology and the Lawrence Berkeley National Laboratory have shown that a highly focused, monochromatic beam of X-rays can be used to obtain chemical maps of working catalysts at a spatial resolution of 15 nm.

The technique — termed scanning transmission X-ray microscopy — uses low-energy (soft) X-rays that are scanned across a sample while the absorption of the beam by the sample is measured. By repeating this process at different X-ray energies, absorbance can be plotted as a function of X-ray energy. This information can then be used to image and distinguish between specific chemical species. Soft X-rays are, however, easily absorbed by matter, restricting the thickness of the sample, and the distance and pressure the X-rays can travel through. To overcome this challenge, the researchers constructed a nanoreactor, which allows them to carry out measurements at atmospheric pressure and temperatures up to 500 °C.

The team have demonstrated their method by monitoring in situ changes to an iron-based catalyst for the Fisher-Tropsch synthesis — a reaction in which CO and H₂ is converted into hydrocarbons.

**SEMICOMDUCTING NANORODS**

**Breathing space**

Nanostructurcs made from the semiconductor cadmium selenide (CdSe) exhibit strong luminescence that could prove useful in electronics or biology. However it can be difficult to characterize these structures because they are near the limit of detection for electron microscopes. Now, Holger Lange at Technische Universität Berlin and co-workers have shown that extremely thin CdSe ‘nanorods’ can be measured using Raman spectroscopy.

Raman spectroscopy is frequently used to measure the size of carbon nanotubes. In the technique, laser light is used to excite a vibration called the radial breathing mode, in which the carbon atoms move in and out as if the nanotube was breathing.

Lange and co-workers observed a similar radial breathing mode in solid CdSe nanorods less than six nanometres in diameter. They could then accurately calculate the sizes of their nanorods, because the vibration frequency depends strongly on the nanorod diameter.

The researchers prepared other CdSe nanorods coated in zinc sulphide, which improves the luminescence of the nanorods and makes them more compatible with biological organisms. These coated nanorods also show a radial breathing mode, but the vibration is at higher frequencies because the zinc sulphide shell compresses the CdSe core.

**THIN FILM LOUDSPEAKERS**

**Nanotube noise**

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**TOP DOWN BOTTOM UP**

**Finding each other**

Combinations of carbon nanotubes and quantum dots can detect DNA and antigens with high sensitivity.

Nearly 10 years ago, Daxiang Cui, now a professor at Shanghai Jiao Tong University (SJTU), started to explore the use of nanomaterials to improve the sensitivity of diagnostic methods for the early detection of bone cancers. Then, in 2004, at a joint symposium between SJTU and Waseda University, he met and became friends with Rina Wu, a dermatologist at the Inner Mongolia Medical College who was also interested in developing ultrasensitive detection technologies. Together, they started to work on new ways to detect DNA with carbon nanotubes and quantum dots.

Wu provided the clinical samples while Cui and collaborators at SJTU and Waseda modified the surface of carbon nanotubes and quantum dots with DNA molecules so that they would each bind to a different part of the target DNA. When all components were bound, the luminescence of the quantum dots in the hybrid state was measured. These DNA-modified nanotubes could detect up to three different targets simultaneously with the aid of three different types of quantum dots. The system could also be extended to an antibody–antigen system suited for biosensor applications (Anal. Chem. 80, 7996–8001; 2008).

“The most difficult part in a collaboration is to make everyone understand and accept each other’s views and suggestions so a uniform agreement can be reached,” says Cui. “Certain methods can be simple for some members but difficult for others, so background knowledge of each other’s specialized area, good communication and understanding are important.”

What advice does he have for collaborators? “It is necessary to select a good coordinator to organize the team meetings and discussions,” says Cui. “Every member should know clearly their tasks and responsibilities. And if the distribution of budget starts to appear unreasonable, it should be quickly resolved through consultation with the members.”

The definitive versions of these Research Highlights first appeared on the Nature Nanotechnology website, along with other articles that will not appear in print. If citing these articles, please refer to the web version.