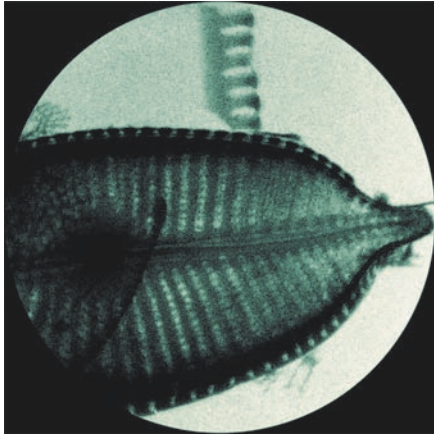


X-RAYS

Bright sparks



© 2008 CSA

Opt. Lett. Doc. ID: 96458 (2008)

The short wavelength of soft-X-ray radiation makes it a good candidate for high-resolution imaging. However, progress is held back by the lack of a suitable laboratory-scale source. Markus Benk and colleagues from Germany have now developed a soft-X-ray microscope that uses a gas discharge light source.

The researchers pass electrical sparks, up to 1,000 every second, through nitrogen, thus generating a plasma. The ions emit light at a wavelength of 2.88 nm (other spectral lines are filtered out), which is directed onto a sample by a grazing incidence collector. By optimizing this collector, the source can produce as many as 10^7 photons $\mu\text{m}^{-1} \text{s}^{-1}$. Enough to image thick samples with an exposure time of as little as 10 s. The principle was validated using samples of diatoms and latex spheres.

Soft-X-ray microscopes are a great hope for the future in applications where high-resolution imaging is required, such as the structural characterization of semiconductor chips, or when investigating thick samples, such as biological specimens. The development of a table-top microscope is important for opening up this technology to the entire research community.

PLASMONICS

Designer deposit

Nano Lett. **8**, 3278–3282 (2008)

Research has shown that nanoparticles of materials, such as gold, can catalyse reactions where the bulk form is ineffective. Now Stephen Cronin and colleagues from the University of Southern California have exploited plasmon resonances to manipulate the growth of carbonaceous nanomaterials.

The researchers deposited 5-nm films of gold onto glass and silicon substrates, forming islands. They then irradiated the sample with a 532-nm-wavelength laser, as carbon monoxide flowed through the reaction chamber.

Raman spectroscopy revealed that on irradiating for a few minutes with a laser power of 12.3 mW, amorphous carbon formed. The researchers were also surprised to see the characteristic Raman signatures of haematite. Although ultrapure carbon monoxide was used, the formation of haematite from trace amounts of iron present from the gas cylinder was efficiently catalysed despite no deliberate feedstock.

By increasing the laser power to 23 mW and the exposure time to 10 minutes, graphite and carbon nanotubes were formed. By moving the laser focus, nanotubes up to 8 μm could be grown in the direction of the laser movement.

Using 785-nm laser light, no carbon was deposited — evidence of the role of resonant plasmons. There was also no deposition when the temperature in the chamber was raised to 900 °C, indicating that temperature gradients due to the excited plasmons were also crucial to enable the dissociation of carbon monoxide simultaneously with formation of iron oxide and carbon-nanotube structures.

OPTICAL FORCES

Trapped nanotubes

Nano Lett. **8**, 3211–3216 (2008)

A collaboration of scientists in Italy and the UK led by Andrea Ferrari has exploited single-walled carbon nanotubes (SWNTs) to achieve optical tweezing with higher spatial and force resolutions than ever before.

To optimize the resolution a full understanding of Brownian dynamics extended to non-spherical objects is required. The researchers imaged SWNTs using a CCD camera. As the image acquisition rate was slow, positional and angular displacements were detected using back-focal-plane interferometry and imaged onto a quadrant photodiode. The researchers compared the Brownian motion of SWNTs with latex spheres, and found that SWNTs have increased axial mobility.

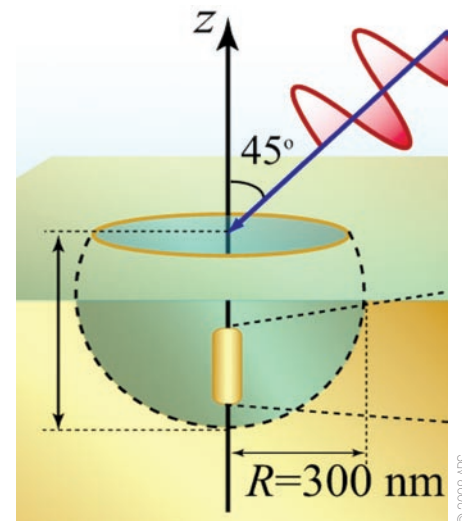
From a combination of measurements and calculations the team was able to derive optical force constants. They then quantified the asymmetry of the spring constants arising from light polarization and found this value to be consistent with the calculated value for spherical particles that are much smaller than the trapping wavelength. This indicated that polarization effects are also

important for extended structures and only depend on the nanoscale transverse size. A plot of a variable quantifying the aspect ratio of the trap's force constants revealed how the optical confining potential strongly depends on the geometry of the trapped particle.

The team achieved a force resolution of 20 fN in the axial direction and a transverse spatial resolution of 40 nm. In addition, the researchers were able to discriminate linear and angular motion by correlation function analysis, which is very important for developing a fundamental understanding of the optical trapping mechanisms.

OPTICAL MANIPULATION

Drowning nanorods



© 2008 AFS

Phys. Rev. Lett. **101**, 136802 (2008)

Placing gold nanorods inside water-filled nanocavities creates a structured surface with optical properties that can be tuned by an external light beam. This is the recent finding of researchers from the Institute of Optics (CSIC) in Madrid, Spain. Rebecca Sainidou and Francisco Garcia de Abajo took gold nanorods approximately 20 nm in diameter and 100 nm long and placed them in spherical craters (300 nm in radius), which were formed on the surface of a gold substrate and submerged in water. They then illuminated the nanocavity with infrared light and discovered that, owing to plasmonic effects, the nanocavity's optical absorption and reflection strongly depends on the position and orientation of the gold nanorod. By applying a 'trapping' light beam to manipulate the gold nanorod the cavity's optical properties can thus be tuned. The researchers say that the effects are also strongly dependent on the wavelength of the trapping beam and believe that the approach could be a useful scheme for all-optical switching.