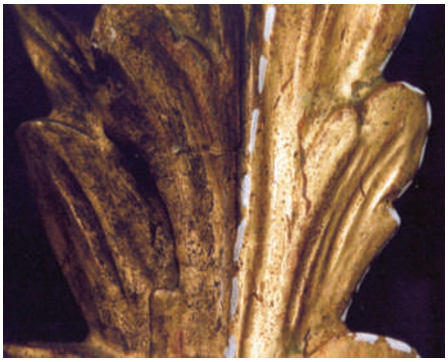
of nanomechanical motion with both high sensitivity and record precision. The researchers used the decaying evanescent field outside of a small optical resonator to probe an array of double-clamped nanoscale beams made from SiN. The frequency noise of the cavity allowed measurement of the array at room temperature to a precision limited only by quantum effects, reaching the standard quantum limit. Furthermore, the pressure exerted by radiation from the resonator affected the motion of the beams, and was even able to drive them into oscillations.

This unique coupling scheme can be applied to a variety of other nanomechanical oscillators, and may lead to new ways of controlling noise and measuring quantum effects in these systems.

NANOCONTAINERS

Clean and spotless art

Angew. Chem. Int. Ed. **48,** 8966–8969 (2009)



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Stable nanodroplets form in microemulsions when two immiscible phases such as oil and water are mixed together in the presence of a surfactant. Many different types of microemulsions exist and they have been used in various cleaning applications. Researchers at the University of Florence now report that nanodroplets in oil-in-water emulsions when embedded in a polymer network can become effective cleaning agents for different pieces of art, including paintings and gilded surfaces.

To preserve the structure and performance of the microemulsion system, Piero Baglioni and colleagues embedded a previously studied *p*-xylene-in-water microemulsion into a hydrophobic hydroxyethylcellulose polymer network with the aim of using the mesh size and viscosity of the network to control the diffusion of the nanodroplets; cleaning agents that are more viscous will penetrate less into the porous matrices of paintings. Small angle X-ray scattering and differential scanning calorimetry experiments confirmed that the structure of the embedded nanodroplets, which was essential for the cleaning process, was retained. The aged protective coating on a fifteenth-century painting and an eighteenth-century gilded frame was successfully removed using the material.

Such water-based cleaning agents offer a simple and less invasive way of cleaning works of art because these systems are optically transparent and cleaning can be visually monitored.

CARBON NANOTUBES

Safe production?

Environ. Sci. Technol. **43,** 8367–8373 (2009)

Chemical manufacturing procedures typically emphasize the need to maximize material performance and minimize production cost. Less attention is paid to mitigating the environmental impact of the production, and this has resulted in costly remediation efforts and redevelopment of technologies. Researchers at the Massachusetts Institute of Technology and the University of Michigan, Ann Arbor now report that side-products from the synthesis of carbon nanotubes, which include potent greenhouse gases and toxic chemical compounds, should be considered when designing the chemical processes.

Using a custom-built chemical vapour deposition reactor, Desireé Plata and colleagues assessed the composition of effluent from the synthesis of multiwalled carbon nanotubes. Thermal pre-treatment of ethane and hydrogen reactant gases produced over 45 side-products including methane, benzene, various volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons. Increasing the temperature accelerated nanotube growth, but it also released more methane and benzene, which can be environmentally harmful. Depending on the size of the market and application requirements, the annual production of nanotubes for flat panel displays and thermal interface materials was estimated to represent between 0.34% and 0.002% of all anthropogenic sources of VOC emissions in the US, which includes industrial, residential and automotive sources.

As the carbon nanotube industry expands, it is suggested that suitable effluent treatment and recycling technologies are implemented when designing new chemical processes.

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.

Top down Bottom up

Perfect match

Researchers in Liverpool have found a unique way to unite the physical and biological sciences.

By the time Raphael Levy arrived at the University of Liverpool in 2002 to begin a postdoc, the collaboration behind his recent publication (*ACS Nano* **3,** 2461–2468; 2009) had already begun. Mathias Brust from the chemistry department and David Fernig from the school of biological sciences had been working together on the use of noble metal nanoparticles for sensing. Levy brought two biologists — Violaine Sée and Michael White — into the fold, along with Brahim Lounis, a physicist from the University of Bordeaux who had developed photothermal microscopy for imaging metallic nanoparticles. The collaboration was later joined by Ian Prior, Dan Rigden, experts on electron microscopy and bio-informatics respectively, and others.

In their experiments Levy and his colleagues watched as gold nanoparticles covered with peptides were swallowed by mammalian cells (a process called endocytosis). Whereas electron microscopy showed that the nanoparticles entered and were stable inside the cells, fluorescence probing revealed that the peptide layer was being destroyed. This was due to the cleaving action of an enzyme called cathepsin L. Bioinformatics tools indicated that this enzyme is capable of cleaving more than a third of the human proteome, making the phenomenon a rather general one. However, the team were also able to demonstrate how to inhibit the cleaving process. The results have implications for nanoparticle-based drug-delivery and imaging applications.

Levy stresses the importance of maintaining a space where discussions between scientists can take place. The group at Liverpool conducted a monthly bionano meeting, out of which several new ideas emerged. Although such meetings can be successfully arranged in most collaborations, it may be harder to follow another of Levy's recommendations: "marry a scientist from another discipline". Levy and the first author on the paper, Violaine Sée, are life partners.