in lasers, LEDs and biological sensors. However, to maximize their usefulness the stability of the luminescence must improve. The fluorescence from these quantum dots tends to blink on and off. The reason for this is not entirely clear, however it has long been believed that the period of the blinking is governed by statistics — a so-called power law — and is unrelated to the dot's temperature and nanocrystal properties. Now, Matthew Pelton and colleagues from the USA have shown that this power-law behaviour does not describe the whole picture. Previous studies of this phenomenon have considered quite narrow timescales, but Pelton *et al.* have extended the study across scales from microseconds to tens of seconds. They observed that the magnitude of the key parameter in the power-law description is not constant but varies with time on a scale of several milliseconds. This suggests that the blinking could in fact be governed by diffusion-control theory, and that the blinking is a result of the slow variation of the energies of carrier trap states. Diffusion-control theory is characterized by a critical time below which the power-law statistics change, in good agreement with the current experimental results.

PHOTOIONIZATION
Probing break ups

GETTY

Science **317,** 1374–1378 (2007)

The study of photoionization dynamics is important for understanding atmospheric chemistry in planetary systems. Ultrashort infrared and UV light pulses are commonly used to probe the dynamics of chemical reactions, but photoionization of atmospheric molecules requires X-ray photon absorption. Now Arvinder Sandhu and colleagues from the University of Colorado and Kansas State University, in the USA, and the Institute of Materials Science and Center for Computational Sciences in Tsukuba, Japan, have successfully generated high-flux, femtosecond X-ray pulses to probe the photoionization of N_2 molecules.

The team up-converted 800-nm-wavelength 28-fs pulses from a Ti:sapphire laser into 30-nm X-ray pulses by passing them through a waveguide filled with argon gas. These X-ray pulses were then used to probe N_2 in conjunction with a reaction microscope — a device that uses a uniform electric field to accelerate reaction fragments towards detectors — to obtain position coordinates and time-of-flight data. The set-up provided data with femtosecond time resolution and ångström spatial resolution from which values for the momenta of the reaction fragments could be deduced.

From the measured data the researchers could perform calculations to deduce the 'shake-up' states of the molecular-ion fragments as the N_2 molecule dissociated. They found that the fragmentation occurred predominantly through antibonding states, where overlapping electrons are out of phase and repel. The technique can be used to explore the dynamics of a range of other atomic and molecular systems.

PLASMONIC NANOSTRUCTURES
Growing pains

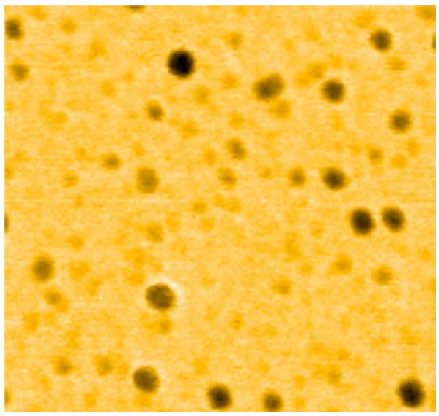
Appl. Phys. Lett. **91,** 121112 (2007)

Metallic nanostructures, with their interesting plasmonic properties, have the potential to benefit sensing, spectroscopic and nano-optical applications. To tap the full potential of plasmonic nanostructures, however, techniques that enable precise control of their shape and position need to be developed.

Researchers at the Institute of Photonic Sciences (ICFO) in Barcelona have now shown that electron-beam-induced deposition (EBID) can create plasmonic nanoscale gold structures with accurate shape and position control. In EBID, a gas of precursor molecules is directed onto a substrate while a focused electron beam is scanned across the surface of the material. The interaction of the electron beam and the precursor molecules causes local decomposition of the molecules and results in the growth of mostly metallic structures.

Although EBID is well established as a maskless lithography tool that can create nanoscale structures, until now it has been impossible to achieve the level of material purity required for plasmonic applications. In their latest work, the ICFO team report on the growth of organometallic dots with a high aspect ratio using EBID to deposit gold onto a glass substrate. They discovered the importance of the surface conducting layer to achieve high-quality deposition, and demonstrate that post-annealing purification processes can be used to confer resonant plasmonic properties on the deposited layer. The method may become particularly relevant for non-flat substrates and overcomes the main limitations of other nanostructuring techniques such as lift-off, where the deposited layer becomes dissociated.

MICROSCOPY
Spot the difference



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The development of scanning near-field optical microscopy has enabled the imaging of particles and features on a scale below that imposed by the wavelength of light. Antonija Cvitkovic and colleagues from the Max-Planck-Institüt für Biochemie and the Centre for Nanoscience in Germany have taken this important technology a step further by showing that it is possible to identify two different materials, even when they are smaller than the probe.

Scanning near-field optical microscopy works by passing a sharp tip very close to the surface to be investigated and collecting light from the non-propagating near field. In this way, more information can be gathered and a better resolution is achieved. But when the features under investigation are smaller than the tip, the situation becomes complicated. Cvitkovic *et al.* show that the signal strength depends on both the feature size and material. By understanding the effect of particle size, it is therefore possible to distinguish between different materials. The researchers show experimentally that this is feasible by using mid-infrared light and a platinum-coated tip with a radius of curvature of 20 nm to image gold and polystyrene particles on a silicon substrate. For particle diameters above 7 nm, the signal from the gold particles is stronger than that from the polystyrene, enabling the two materials to be distinguished. The scientists suggest that this minimum particle size could be further reduced by using a finer-tipped probe.