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Physics news on the Internet (based on electronic preprints)

1. Quantum states of Rydberg atoms

An unprecedentedly deep insight into the amplitudes and phases of wave functions of atoms has been given by P Bucksbaum and his group at Michigan State University using a more direct experimental technique than ever before in the field. The Rydberg atomic states were chosen, whose energy range and hydrogen-like structure make them particularly suitable for investigation. The atoms were first exposed to a 150-fs laser pulse spectrally tailored to excite them into a set of eight energy states. A second pulse then brought the atoms into yet another combination of the same states so that the resulting wave function was a superposition of wave packets from the pair of pulses and the atoms so produced were able to interfere with one another. From the study of atomic ionization by electrical pulses, the distribution of electrons over the quantum levels was obtained, thus allowing the wave function amplitude and phase to be derived. The results agree exactly with the predicted effect of the applied pulse pair.

Source: http://publish.aps.org/FOCUS/

2. A new carbon form

A new form of solid carbon, a C-36 molecule, has been created at the Berkeley National Laboratory. C-36 appears together with C-60 fullerene in an electric arc between two graphite electrodes and is expected to be very interesting in terms of its electrical and chemical properties.

Source: http://www.nature.com/

3. Nanoscale electrochemistry

While dissolved substances usually react throughout the entire solution volume, a new technique developed by a Berlin research team led by R Schuster is capable of confining electrochemical reactions on a nanometer scale within the solution. The experiment involved an electrically conducting copper sulfatesulfuric acid electrolyte with a tunneling microscope needle and a gold surface acting as electrodes. A 60-ns voltage pulse applied across the electrodes causes a 5-nm-diameter pit 0.3 – 1.0 nm deep to appear on the gold surface. Gold ions attracted by the needle acquire an electron and so become neutral. Reversing the voltage led to the deposition of 8-nm-diameter 1-nm-high copper clusters from the solution.

Source: http://www.hep.net/documents/newsletters/pnu/pnu.html#RECENT
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4. Crystal growth

Although dendritic structures are ubiquitous and may be found in many metals, rocks and even in ordinary snowflakes, it was only about a decade ago that a mathematical theory of crystal growth was developed. In their experiments on snowflake growth under an electric field, American researchers K Libbrech and V Tanusheva observed a growth rate increase by more than a factor of 10 beyond a certain critical value of the electrical potential. By including the electric field in ordinary crystal growth theory, it is shown that a large field gradient arises near sharp crystal edges, which polarizes vapor molecules and attracts them to the crystal. New experimental techniques developed by the researchers allow precise control of crystal growth and may be useful for producing and investigating a wide range of materials.

Source: http://ojps.aip.org/prlo/top.html

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