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1. Superconductivity in magnesium diboride

Three research groups have independently observed that doping MgB_2 with certain elements considerably increases the critical current and magnetic field needed to destroy superconductivity in this intermetallic compound (see *Usp. Fiz. Nauk* **171** 306 (2001) [*Phys. Usp.* **44** 330 (2001)] for a review of the discovery of superconductivity in MgB_2). The destruction of superconductivity relates to the appearance of a large number of vortices in the material and is due to the energy losses caused by the interaction of the moving vortices with the superconductor's crystal lattice (lattice defects produced by impurities act to slow down or stop the motion of the vortices). At the University of Wisconsin in the US, a current density $j = 10^5$ A cm^{-2} was achieved at $T = 4.2$ K and a magnetic field $B = 10$ T by doping MgB_2 with oxygen. Yu V Bugoslavskiĭ of the RAS General Physics Institute and his British colleagues were able to halt the vortex motion by irradiating the superconductor with protons, thus doubling the critical magnetic field. The third group, at Lucent Technologies, achieved $j = 3 \times 10^4$ A cm^{-2} at $T = 25$ K and $B = 1$ T in a MgB_2 sample in contact with iron. The discovery makes magnesium diboride even more promising for practical applications.

Source: *Nature* **411** 558 (2001);
http://physicsweb.org/article/news/5/5/15

2. Chemical properties of element 108

A group in Darmstadt, Germany, have for the first time studied the chemical properties of element 108 (hassium) discovered in 1984 and found it to form a gaseous oxide similar to that of osmium. The study became possible thanks to a separation and detection technique developed for group 8 elements at Berkeley Lab. Hassium nuclei were obtained in fusion reactions occurring in a ^{248}Cm target bombarded with a beam of ^{26}Mg ions. Upon oxidation, the nuclei were transferred into a detector by a helium flow, where they condensed in a pattern of rows on a semiconductor surface. The rows remained stable at somewhat higher temperatures (around $-20\,^{\circ}$C) than their osmium oxide counterparts. Element 108 is the heaviest element yet whose chemical properties have been successfully investigated.

Source: http://unisci.com/stories/20012/0525016.htm

3. Single-bubble sonoluminescence

The phenomenon of sonoluminescence discovered in 1934 is the emission of light due to the fact that air bubbles in water collapse under the action of sound (see *Usp. Fiz. Nauk* **170** 263 (2000) [*Phys. Usp.* **43** 259 (2000)]). Water normally contains a great number of bubbles, which only collapse after first clustering together rather than individually. In the multibubble sonoluminescence spectrum, an OH emission line is observed. In 1998, the collapse of single bubbles created by a focused sound wave was observed for the first time, but since there was no OH line seen, an emission mechanism different from that in the multibubble case was thought to be at work. Now University of California researchers using laser beams have produced isolated bubbles of much larger size than in previous experiments. It is found that large individual bubbles do show an OH emission line, but the origin of the line remains unclear. The researchers conclude that the OH line relates not to the emission mechanism but rather to the size of the bubbles because in the case of multibubble sonoluminescence each cluster of collapsing bubbles is like a single bubble of a larger size. Also, according to the new studies, the sonoluminescence spectrum is close to that of a black body at a temperature of about 8,000 K suggesting the presence of a hot plasma inside the collapsing bubbles.

Source: http://focus.aps.org/open/st23.html

4. Sound induced crystallization

The crystallization of a liquid under the action of sound has been achieved for the first time by a group at Ecole Normale Superieure (ENS) in Paris by sending short 200-dB ultrasonic pulses into liquid helium at a temperature close to the solidification point. During the passage of the pulse, islands of solid phase were observed to grow at a rate of 100 m s^{-1} to as much as 15 μm in size, which then melt away equally rapidly in the decompression wave that follows.

Source: *Physics News Update*, Number 541
http://www.aip.org/physnews/update/541-2.html

5. Dust clouds around brown dwarfs

Dust disks similar to protoplanetary disks around stars were found to surround several brown dwarfs in the Orion Nebula by researchers at the University of Florida. These brown dwarfs are in a young cluster, and many ordinary stars in their neighbourhood are also surrounded by such dusty disks. Brown dwarfs are intermediate in mass and brightness between stars and giant planets. The dust disks offer the suggestion that brown dwarfs are closer to stars than to giant planets genetically and that they themselves may have planetary systems around them.

Source: http://unisci.com/stories/20012/0608011.htm

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