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News Briefs

"BUCKYBALLS" – SUPERCONDUCTORS OF THE FUTURE ?

Investigation of the interstellar formation of long carbon chains in red giant stars led the scientists at the Rice University, Houston, U.S.A. to the unexpected discovery, in 1985, of a third natural form of carbon – the stable C_{60} molecule. They suggested that C_{60} took the form of a closed cage resembling a soccer ball and called the molecule *buckminsterfullerene* in honour of the architect R. Buckminster Fuller and the geodesic structures he had designed which exhibit the same form.

The discovery has turned out to be one of the rare research breakthroughs that fundamentally alters conventional scientific wisdom and triggers an explosion of multidisciplinary research. It upset centuries–old chemical tradition that just two forms of carbon existed, graphite and diamond. It has since opened up new research areas in chemistry, physics, materials science, medicine and other disciplines.

Shortly after the discovery of the fullerenes physicists found high–temperature superconductivity in alkali–doped "buckyballs". With endohedral complexes, one can choose not only the physical properties but also the electrical or magnetic properties of the cage. The behaviour of C_{60} crystals depends on how close atoms are together, and if one can put atoms inside them, then it may be possible to tune the electrical properties to produce very high–temperature superconductors.

The study of C_{60} and other fullerenes is the hottest area of science today: it accounts for nine of the 23 hottest papers of 1991, it was selected, in 1991, "The Molecule of the Year", and "The Renaissance Molecule" in 1992.

SUPERCONDUCTIVITY ABOVE 150 K AT HIGH PRESSURES

Recently, superconductivity at >130 K was reported in multiphase samples of the compound system $HgBa_2Ca_{n-1}Cu_nO_{2n+2+\delta}$ (Hg–12(n–1)n) with n = 1,2,3,...

Single–phase Hg–1223 was subsequently synthetised and found to be superconducting at a record temperature of 135 K. The application of pressure generally increases the T_c of underdoped layered cuprates, with a pressure derivative of T_c that decreases with increasing doping. Scientists from the University of Houston, U.S.A. have recently reported (*Nature 365* (*1993*), *323*) the observation of superconductivity at up to 153 K in Hg–1223 at 150 kbar, with a main transition at 147 K. This observation provides an indication that superconductivity at >150 K may be possible in this system at ambient pressure, if suitable forms of chemical substitution can be found.

MULTI–TESLA PERMANENT MAGNETS

Both cylindrical ("magic ring") and spherical ("magic sphere") dipolar permanent magnetic field sources are capable of providing arbitrarily high fields in their interior cavities. However, since the obtainable field increases only logarithmically with the structural radius, fields above about 2.5 T necessitate excessively massive and costly structures if working volumes of more than a few cm^3 are desired. It has recently been shown by the scientists from the U.S. Army Electronics Technology and Devices Laboratory (*J. Appl. Phys. 73 (1993), 6861*) that for some cavity shapes the structures can be modified to produce fields up to 4.0 T with only about one fifth the mass and bulk of the conventional structures.

MAGNETIC DEVICE RID OF CROWS FROM TOWERS

Mitsui Ltd. (Japan) is testing a magnetic device which drives crows away from transmission line towers. Crows and other birds often make nests on transmission line towers which cause stoppage of power supply. Snakes climb the towers to catch the eggs of birds and die from electric shock. There has been no effective measures so far. The new device utilizes the fact that birds have biomagnets in them, preventing birds from approaching due to a disturbance in magnetic field.

GERMANY DECIDES ON SUPERTRAIN

The German Cabinet decided early in March 1994 to build Europe's first high–speed magnetic railway system between Berlin and Hamburg by 2005. The train will propel commuters at speeds of up to 434 km/h at rooftop level and will cut travelling time from more than three hours to 53 minutes.

A NEW FIELD RECORD FOR A HIGH T_c SUPERCONDUCTOR

A superconductor containing bismuth, lead, strontium, calcium and copper oxide has set a new record for the strongest magnetic field ever generated by high–temperature superconductors. In a joint research project between Argonne National Laboratory (USA) and Intermagnetics General Corp. (USA), a high–temperature superconducting coil cooled by liquid helium, operated at 4.2 K and carrying the electric current of 234 A generated a magnetic field of 2.6 T, compared to previous record of 1.75 T. At higher temperatures of 27 K and 82 K the system carried 160 A and 32 A and generated magnetic fields of 1.8 T and 0.36 T, respectively.