Nanometerscale Architecture

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In 1985 carbon, as a material, appeared to be fairly well understood and it was not the prime focus of any major fundamental initiative. It is important to remember that C_{60}, Buckminsterfullerene was found accidentally during a set of focused experiments which derived directly from microwave spectroscopy and radioastronomy studies in the mid to late 70's. It now seems clear that the molecule would have been discovered during some equally fortuitous study fairly soon anyway as a consequence of the fact that cluster science was developing rapidly during the 1980's rather than a study aimed at fundamental behaviour of carbon. It had furthermore been lurking around undetected in fairly copious quantities in combustion studies for decades.

The discovery has led to other fullerenes, as well as the related carbon nanotubes (Buckytubes), heralding a new era in materials technology. The amazing nanotubes may be a millionth of a millimetre in diameter and extremely long - indeed, they may be of unlimited length, perhaps one day many miles. If and when we eventually master their production, all the evidence suggests that it should be possible to create mechanical structures and electrical devices with amazing mechanical properties close to the limit imposed by the chemical bond. The electrical and magnetic properties are equally exciting in that these structures offer the first plausible solutions to some of the problems posed by the miniaturisation of electronic devices which will be required in the development of molecular computers. These fascinating possibilities are responsible for the massive worldwide research effort into the production and behaviour of these novel materials, which have already resulted in many very interesting results.

In the Sussex Nano-Science and Technology Centre at the University of Sussex, novel electrolytic (condensed phase) and metal-catalysed thermolytic (vapour/solid phase) techniques have led to the production of new carbon, boron nitride, silica and silicon nanotubes and nanofibres with intriguing structures. Advanced materials behaviour has been detected and fascinating insights into the formation mechanism revealed. The applications promise of these materials ranges across civil engineering structures with incredible strength, super low-loss electrical conductors and optoelectronic components minute enough to make pocket supercomputers possible. However if this promise is to be realised nothing less than a complete revolution in the synthetic strategies available for materials production may be necessary. This new area of materials science presents one of the greatest technical challenges of the 21st Century.