Controlled growth of truly nanoscale single crystal fullerites for device applications

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(PhysOrg.com) -- University of Surrey researchers have found a way to make ultra-small pure carbon crystals entirely formed from the spherical carbon 'buckyball' molecule known as C60. The method used involves mixing two liquids together, one of which contains C60, at low temperature.

Lozenge shaped crystals can be quickly obtained with widths of 80 nm which is about 100,000 times smaller than the width of a pencil and much smaller than previously thought possible using this method. The electronic properties of the C_{60} molecules that make up the small crystals are of particular importance for developing new nanoelectronic devices such as solar cells and gas sensors.

This new development may therefore allow researchers to accelerate the development of these nanotechnologies based on this simple method of making these high purity ultra-small C_{60} components.

The work which is highlighted on the front cover of the 28th July 2008 issue of the Royal Society of Chemistry's *Journal of Materials Chemistry* demonstrates a fast and simple method of making C60 fullerite crystals with diameters of 80 nm. Importantly for future applications the fullerites are produced in high yield and their shape controlled through the variation of solvent, concentration and temperature. Significantly this work demonstrates that existing models of fullerite growth need re-evaluating as these models predict a minimum size of ~400 nm, well above that demonstrated by the team.

The ability to produce large quantities of fullerites raises the potential for their incorporation into devices to enhance a desired property. Possible applications of fullerite rods include adsorbents, catalysts and membranes due to their relatively high surface area to volume ratio. Potential electronic devices that may benefit from such materials include n-type organic transistors due to relatively high electron mobility of $C6_{60}$ (~0.1 cm-2V-1s-1), optical devices, thin film organic solar cells, organic light emitting diodes and photodetectors.

Researcher Lok Cee Chong said: "The ability to control fullerite growth on a nanoscale may lead to a number of exciting applications. We are just beginning to obtain glimpses of these in my current work as I complete my PhD".

Dr Richard Curry who leads this research said: "The results of this work are of immediate significance to a wide range of technologies that use organic materials. These new nanoscale carbon materials will allow us to continue to develop enhanced devices such as sensors and solar cells to address the grand challenges facing society today".

Prof Ravi Silva, Director of the Advanced Technology Institute (ATI), said: "This is very exciting work of the type that leads to further serendipitous discoveries. Ultimately it demonstrates how the ATI and wider research carried out in the UK continues to lead the world in the development of new technologies".

The full research paper is available from the Royal Society of Chemistry Journal of Materials Chemistry website: www.rsc.org/Publishing/Journal … cle.asp?doi=b802417k

Source: University of Surrey