

What's Hot In... > What's Hot in Chemistry - Menu > Miniscule Particles with Massive Potentials

FOLLOW US **SHARE**

MINISCULE PARTICLES WITH MASSIVE POTENTIALS

WHAT'S HOT IN SEPTEMBER/OCTOBER 2011

SCIENCEWATCH HOME INSIDE THIS MONTH ... **INTERVIEWS** SPECIAL TOPICS **ANALYSES** Featured Analyses

What's Hot In..

DATA & RANKINGS ABOUT SCIENCE WATCH

FOLLOW US ON twitter

SHARE

by John Emsley

Graphene continues to dominate the Hot Ten, but there is a paper, #6, which manages to combine graphene chemistry with another popular topic: nanochemistry. It comes from a group at Pacific Northwest National Laboratory in Richland, Washington, led by Jun Liu, working in collaboration with Ilhan Aksay of Princeton University. Paper #6 concerns titanium dioxide-graphene hybrid nanocrystals, which could benefit lithium-ion storage batteries.

TiO2-graphene nanocomposites are not new, but the method of making them by Liu and colleagues is. It uses graphene sheets dispersed in an aqueous solution of the surfactant sodium dodecyl sulfate, and it is on these that nanocrystals of TiO2 are deposited. The process is a mild, low-temperature (below 100 °C) crystallization which results in either of the crystal forms of TiO2, namely rutile and anatase.

The nanocrystals varied slightly in size, with the rutile ones being 6 nm and the anatase ones 5 nm, as measured by transmission electron microscopy. Rutile crystals were in the majority under the conditions described above, although the distribution shifted in favor of anatase when sodium sulfate was added to the solution.

The effectiveness of these so-called functionalized graphene sheets (FGSs) was demonstrated as the electrodes of a typical Li-ion battery. Between 0.5 and 2.5% FGS was added to the electrodes, and this more than doubled the charge and discharge rates, the effect being attributed to the presence of the graphene network now embedded in the metal oxide electrodes. Paper #9 in the list is also about

spectroscopy (SERS)—so dramatic that it permits the characterization of individual molecules. The Raman spectrum of a molecule arises from its vibrational modes of bonds within the molecule. SERS is a technique which has become widely used once it was realized that if the sample to be investigated was deposited on a nano-structured surface, such as gold or silver, the

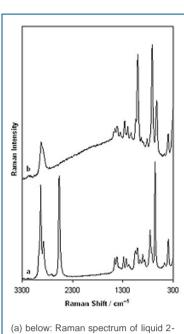
another remarkable effect due to nanoparticles: in this case, of gold nanoparticles coated with a layer of an oxide, either silica or alumina. These have a dramatic effect on the analytical technique known as surface-enhanced Raman

molecule. Now two groups of researchers, one based at Xiamen University, China, and headed by Zhong Qun Tian, the other at Georgia Institute of Technology, Atlanta, have

sensitivity would be enhanced a

millionfold, even to the extent of

permitting detection of a single



mercaptoethanol and (b) above: SERS spectrum of 2-mercaptoethanol monolayer formed on roughened silver. SERS measurement was carried out for metal substrate immersed in a 10 mM 2-mercaptoethanol aqueous solution. Spectra are scaled and shifted for clarity. From the Wiki Commons.

enhanced Raman spectroscopy). In this, the sample to be investigated is placed on the surface of a single crystal of platinum covered with a layer of hydrogen, and then dusted with a layer of the silica-coated gold nanoparticles. (The silica film acts to insulate the gold from direct contact with the sample.) The result is a Raman spectrum of sufficient sensitivity to identify molecules of the pesticide parathion on an orange peel, as well as biomolecules on the

collaborated and come up with SHINERS (a.k.a. shell-isolated nanoparticle-

surface of yeast cells. And still on the theme of nanochemistry there is, just offstage at #11, a paper by Peidong Yang and Erik Garnett of the University of California, Berkeley,

which could have significant implications for solar cells. (E. Garnett, P. Yang, Nano Lett., 10[3]: 1082-7, 2010; 32 citations this period, 63 overall.) These two have demonstrated that ordered arrays of silicon nanowires have

excellent light-trapping ability and that these can be fabricated easily and have

efficiencies of between 5 and 6%. The method of fabrication consisted of dipping a silicon wafer into an aqueous suspension of silica beads, followed by deep reactive ion etching using each bead as an etch mask from which to grow the nanowires. The beads were then removed using hydrofluoric acid. Finally, at #17, is another nano paper of an entirely different kind. This reports a nanoscale porous metal-organic framework (MOF) that could be used for

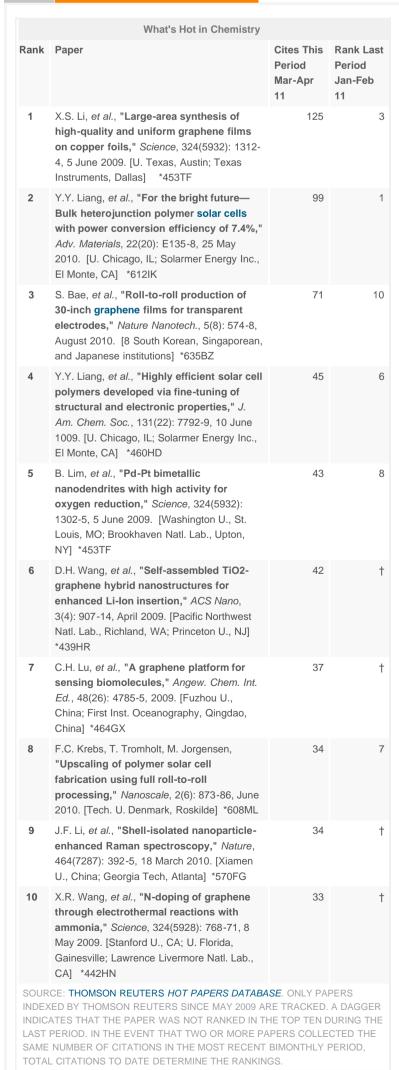
various institutions in France and Korea, and led by Patricia Horcajada of the Institut Lavoisier, Versailles, France. (P. Horcajada, et al., Nature Mater., 9[2]: 172-8, 2010; 27 citations this period, 69 total.) The MOFs were compounds of iron(III) carboxylates of acids such as muconic acid and fumaric acid. Within their enormous cavities, various drugs such as retroviral and anti-tumor compounds could be accommodated and delivered

drug delivery. The development comes from a 19-strong group based at

University, U.K.

Dr. John Emsley is based at the Department of Chemistry, Cambridge

more effectively to where they were needed.



EMAIL | BACK TO TOP ^

CITE THIS PAGE: http://sciencewatch.com/ana/hot/che/11sepoct-che/

What's Hot In... What's Hot in Chemistry - Menu Miniscule Particles with Massive Potentials

WHAT'S HOT IN...

- Biology
 - Chemistry
 - Medicine
 - Physics Home

MORE ANALYSES

- Featured Analyses
- Special Topics