

Carbon Newsletter

Number 37 July 2009

Capturing Carbon Images

NanoteC09

Capital Carbon meeting 2008

Other future carbon and coal meetings

Political thoughts on CCS

Editorial

Summer is allegedly upon us and the next BCG event is NanoteC 09 in September. This year it moves once more outside the UK and will be held in Brussels. Although details have been posted on our website, I give full details here because even though most members will not be going, I'm sure they will be interested in the programme, including as it does this year, rather daringly perhaps, a session on political aspects of nanotechnology as it applies to carbon materials.

A major feature of this issue is the inclusion of our entries for "Capturing Carbon". We had a very good response to this competition and the winner was given a trophy to commemorate his success at our AGM/ Capital Carbon meeting in London last December. Some of the entries are posted on our website but it was thought worth while to record them all, so those of you who have not had a chance to see them can browse through them now. The Group has clearance for copyright for our publications, but should you want to use any for other than private purposes, you should clear it with the authors.

Talking of the Capital Carbon meeting, we have held these for the past few years and they have been scientifically very successful, with very good speakers giving an overview of progress in their different areas of expertise. I have enjoyed the chance of being painlessly informed of progress over a wide area of carbon science and technology. The attendance on the other hand for what is a low cost meeting and that generally contains our AGM, has not been all that the committee might have wished. We are experimenting this year with a meeting outside London and Nicole Grobert is investigating Oxford as a venue. We hope to have as central theme, results of applications of computational methods to carbon research. The meeting will be in mid-December, so please make a note of this: fuller details will be circulated nearer the time.

The Group does support student attendance at meetings, both by a reduced fee for students coming to our own meetings and by offering bursaries for other relevant meetings. This partly reflects our relatively sound financial position but education and information is also a condition of our charitable status. The rules for applying for these bursaries, together with a sample application form are reproduced elsewhere in this newsletter. As editor, I have to emphasise that the only condition of being awarded one is that you have to sing for your supper, so to speak, and write an account of your impressions of the meeting for inclusion in these pages. One such account, of Carbon 2009 appears in this issue.

Finally, the controversy about climate change shows no sign of abating. In the UK, there is the potential conflict between measures to reduce emissions of carbon-containing gases and an increasing perceived "energy gap" where we are becoming dangerously short of power supplies for winter needs. Harry Marsh has already written in our last newsletter about the need, as he sees it, for urgent action but others have criticised the Government for failure to provide adequate funds for a robust programme to effect this. Carbon Capture and Storage (CCS) is one way of continuing to be able to use carbonaceous fuels and don't forget, that whatever we do in this country or in Europe generally, the Chinese have firm intentions of burning 2000 million tons of coal by the year 2020. I am including a controversial article here by Sonja Boehmer-Christiansen containing amongst other topics, her own personal feelings about CCS. You may well disagree with her (I certainly do on some points): in which case, I shall be delighted to reproduce your comments in the next issue, subject to the usual proviso about their suitability for appearing in the public domain.

Norman Parkyn *norman.parkyn@tesco.net*

NanoteC09

Nanotechnology in Carbon and Related Materials

FINAL ANNOUNCEMENT

www.britishcarbon.org/nanotec

We are pleased to announce **NanoteC09** at Hotel 'Le Plaza' in Brussels from 26-29th August 2009.

Please note the NEW Conference deadlines:

- **Abstract submission deadline: Friday June 19th 2009**
- **Early registration deadline: Wednesday 24th June 2009**
- **Room reservation at special conference rates: Saturday 25th July 2009**

NanoteC09 will bring together scientists working in the broad area of **carbon science at the nanoscale**: nanotubes, fullerenes, nanohorns, graphene, nanowires, sp^3 forms, etc. While each of these materials attracts its own dedicated community of researchers, **NanoteC** draws on common themes and allows researchers to share insight into this unique element at the nanoscale. **NanoteC** also provides a platform to explore wider issues in nanoscience such as toxicology and science communication.

NanoteC09 will contain dedicated sessions on **synthesis, microscopy and spectroscopy of carbon nanotubes and related systems, nanocomposites, graphene, devices and electronic applications and theoretical modelling**, combining both fundamental knowledge with applied research. A special session on **science policy** will explore the interface between science, politics and science policy, with speakers from various political, lobbying and scientific policy organisations. Together with issues around science communication and diversity, a **round table debate** to share views on these issues between all participants.

Confirmed Speakers

- **Millie Dresselhaus**, MIT, Boston
"Developments in optical spectroscopy of carbon nanomaterials"
- **Kazu Suenaga**, AIST, Tsukuba, Japan
"Defects in low-dimensional carbon"
- **Alex Savchenko**, Exeter University, UK
"Transport studies of graphene"
- **Alan Windle**, Cambridge University, UK
"Structure and properties of direct spin carbon nanotube fibres"
- **Kostas Kostarelos**, University of London, UK
"Nanotubes: how does structure affect biological and toxicological function?"
- **Carla Bittencourt**, Mons University, Belgium
"Reactivity of carbon nanotubes"
- **Bojan Boskovic**, Nanocyl, Belgium
"Engineering and production of carbon nanotubes"
- **Gotthard Seifert**, TU Dresden, Germany
"Theoretical modelling of carbon nanostructures"
- **Junji Haruyama**, Tokyo University, Japan
"Superconductivity in boron-doped carbon nanotubes"

- **Martine Mayne**, CEA Saclay, France
"Nanoscale carbon composites: fundamentals and applications"
- **Arkady Krasheninnikov**, Helsinki University of Technology, Finland
"Irradiation of carbon nanomaterials: from defects to self-organization"

Nanoscience and politics at NanoteC09.

The conference will contain some of Europe's best academic nanoscientists - not necessarily those who would normally be involved in the science-politics interface, but those who are actually devising and executing Europe's nanoscience R&D. This will be a fantastic opportunity to share your views with them, and hear what they have to say.

NanoteC is famous in the nanoscience community for its friendly and informal approach. The programme runs for three days and is primarily presentations of cutting-edge scientific research, however the Friday afternoon is devoted to 'broader topic' subjects, in previous years including science communication and women in science. This year we want to focus on the interface between science and politics - what is it that scientists feel politicians and civil servants need to hear, that they currently are not? What is it that the politicians think the scientists need to hear that they're not? What do both groups want to hear from the other? What are current policy developments concerning nanotechnology? Will they directly impact on researchers in carbon nanoscience, and what input should the scientists be having on this? What areas do participants feel need legislation, and how should this be achieved? How can the political process serve to encourage diversity within nanoscience, both in terms of subjects under study, the balance between fundamental and applied, as well as the human side to nanoscience: gender balance, and involvement of minority groups?

We really want this meeting to be a great opportunity for both sides of the science-politics fence to talk together, in an informal, open environment, and ask the questions that have been on their minds.

You are of course very welcome to attend any or all of the conference if you want, but otherwise the Friday afternoon session will only take a few hours of your time. From 13:00-15:00 we will have some academic presentations on toxicology and bio-related carbon nanoscience, followed by a break for coffee. The science-politics session should then run from 15:30 to 17:30, beginning with short 5-15 minute presentations from key players (from the DG, COST, DIVERSITY, lobby groups, etc), followed by an open floor discussion, stimulated via the conference organising committee and others who will act as 'roving microphones'.

Participation at NanoteC is typically around 80-140 people, and you can see more details on our website at www.britishcarbon.org/nanotec Current scientific participants include Millie Dresselhaus (former science advisor to Bill Clinton), Nicole Grobert (advisor to the UK House of Lords Science and Technology select committee and UK representative of the EU DIVERSITY project) and Carla Bittencourt

(chairperson of NanoTP, the COST supported largest nanotechnology research network in Europe).

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NanoteC09

26-29th August 2009

www.britishcarbon.org/nanotec

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BRITISH CARBON GROUP STUDENT TRAVEL BURSARIES - GUIDELINES FOR APPLICANTS

The British Carbon Group has funds available to assist **student** travel for participation in national and international meetings relating to the science and technology of carbon materials. Please note, applications are for travel funds only, **not** for conference fees or accommodation. Sums awarded are normally up to £75 for a UK conference and up to £200 for international conferences. Preference will be given to students, normally postgraduates registered for a research degree, who are:

- a presenting author at the conference
- promoting UK carbon research
- attending a conference organised by the British Carbon Group
- also trying to get money from other sources.

Applicants should also note that as funds are limited, and to ensure an equitable distribution of funds, normally only one bursary may be awarded to the same research group / department for conferences in any given calendar year. Awardees are expected to join the British Carbon Group via the RSC, IOP or SCI or already be members.

Applicants, if awarded a BCG Student Travel Bursary, must write a short article (500 words) on some aspect of the meeting or their area of carbon research, for consideration for inclusion in the BCG Newsletter. Cheques will only be issued after the conference has taken place and on receipt of the short article mentioned above.

Applications should be made in writing on this form and they **MUST** be accompanied by a letter from the student's supervisor or Head of Department supporting the application and **specifying to whom any cheque should be made payable.**

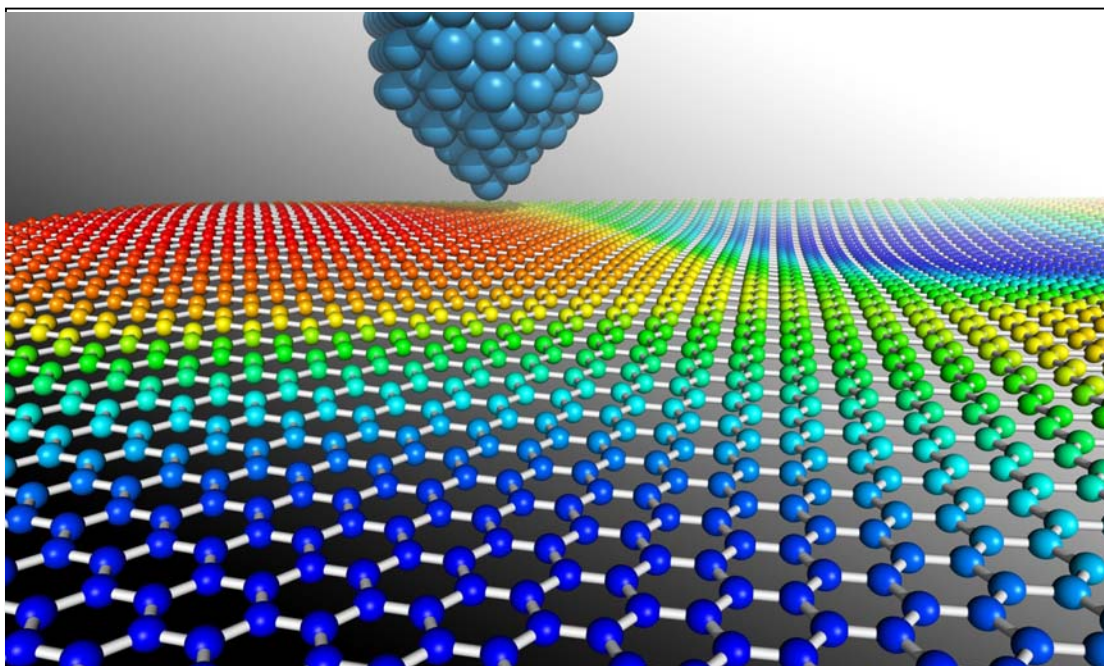
A sample application form is available on our website (see above).

Agreement signed with Brazilian Carbon Group

The BGC recently signed an agreement with the Brazilian Carbon Group (ABCARB) whereby members of each organisation are entitled to register for each other's meetings at members' rate. This agreement will last for 5 years and is part of scheme where we are trying to encourage the collaboration and growth in carbon science in other countries, especially where it is in an early stage of development.

"Capturing Carbon" competition

Graphene



In July 2008, Levente Tapasztó *et al* (1) reported their ability to etch graphene nanoribbons using a scanning tunnelling microscope to produce almost atomically precise structures and predetermined electronic properties. This image shows a tungsten [100] scanning tunnelling microscope tip approaching a stylised sheet of perfect graphene, undulating with a wavelength of 8 nm, as predicted by Fasolino *et al* (2) in 2007.

1 Tapaszto et al. Tailoring the atomic structure of graphene nanoribbons by scanning tunnelling microscope lithography. *Nat Nanotech* (2008) vol. 3 (7) pp. 397-401

2 Fasolino et al. Intrinsic ripples in graphene. *Nat Mat* (2007) vol. 6 pp. 858-861

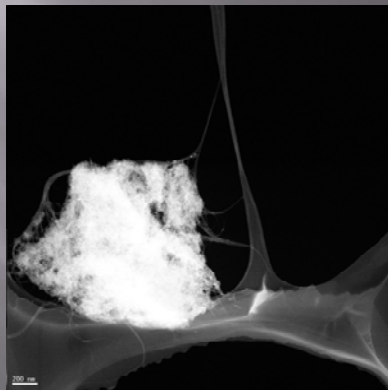
Fundamental Carbon



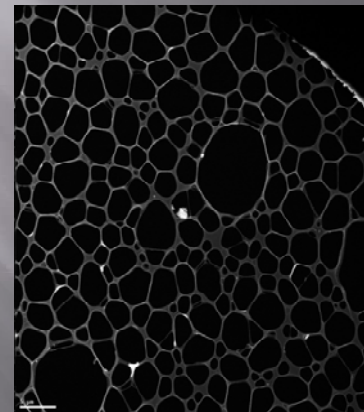
Unnoticed Inventor



Amorphous Carbon: The Microscopist's Best Friend



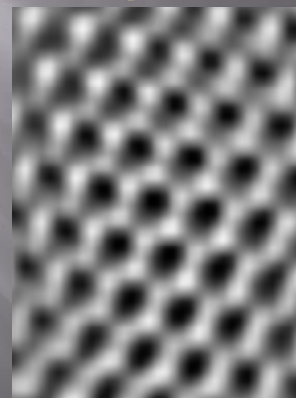
Carbon Nanotubes on Carbon Grid



Pencils of Graphite



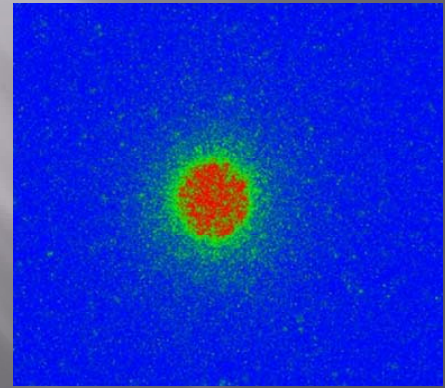
Single Carbon Atoms in Graphene



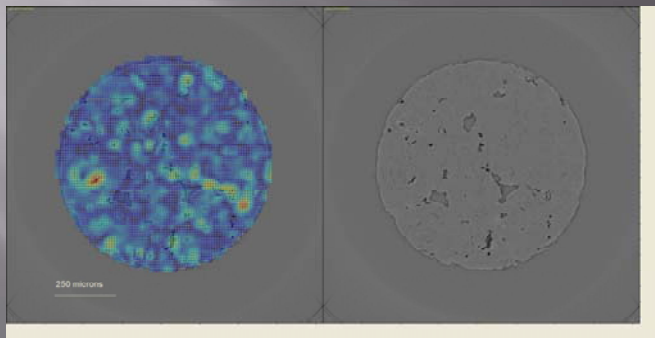
2 Hairs vs 2 Million Carbon Nanotubes



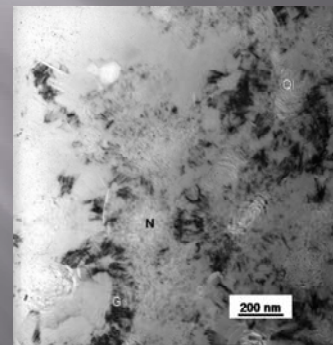
Neutron Activated Graphite



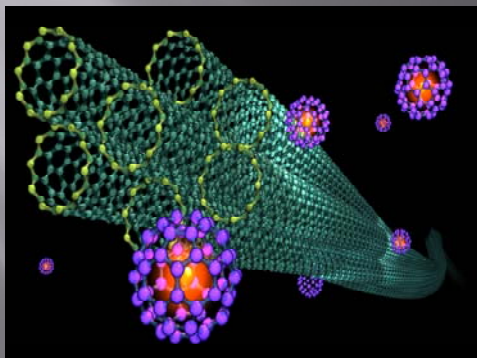
Mapping of thermal strains within the microstructure of Gilsocarbon nuclear graphite



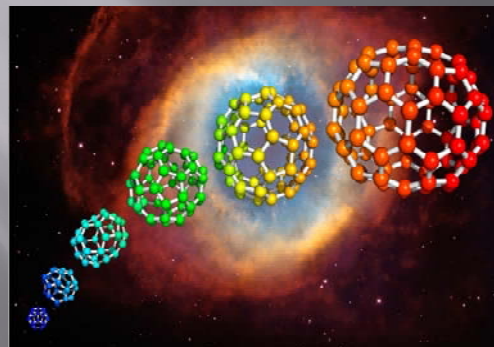
Transmission electron microscopy image a binder microstructure in Gilsocarbon nuclear graphite

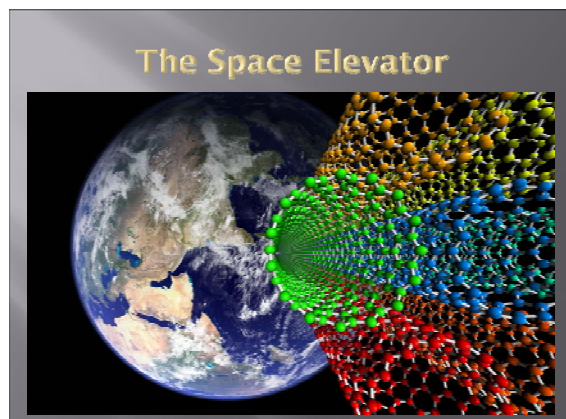


Carbon Nanoforms



The Fullerenes





Captions to competition entries

Fundamental carbon: The idea behind this was that as well as being integral to any kind of invention or technology, carbon is usually the medium through which these inventions are first brought to life through the humble pencil, a tool which has arguably contributed more to human knowledge than any other.

Lewis Bush

Unnoticed Inventor: This was a similar idea, only visually I wanted it to be less obvious, I wanted it to look like the shavings from a engineer or scientists pencil which had just been cast aside, but which were fundamentally key to the job they were doing.

Lewis Bush

Carbon Nanotubes on carbon grid (SERIES-MM.jpg). Carbon nanotubes, bundled together with organic coated oxide nanoparticles, attach themselves to the surrounding amorphous carbon grid like tendrils.

Dr Alexander Gloter, at the "Laboratoire de Physique des Solides" in Orsay, Paris

Amorphous Carbon : The Microscopist's Best Friend (SERIES-LM.jpg). Amorphous "holey" Carbon Grid. This fine network of carbon strung together in the void of the microscope column is every microscopist's best friend, trapping samples like flies on a spiders web.

Dr Alexander Gloter, at the "Laboratoire de Physique des Solides" in Orsay, Paris

Pencils of graphite or Graphite of pencils: Graphite is a black mineral, the most common form of carbon, used in the core of pencils. Graphite is made from layers of carbon atoms, in each layer the atoms are packed in a hexagonal 'honeycomb' array. Curiously, if pack a bundle of pencils they also adopt the same hexagonal packing. The picture shows just such a bundle of pencils with an atomistic model of a graphitic layer superimposed in order to show the link between the macroscopic and nanoscopic worlds.

Irene Suarez Martinez

"Single carbon atoms in graphene"

Valeria Nicolosi

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2 Hairs vs 2 million Carbon Nanotubes

Scanning electron micrograph of two human hairs (upper left) and the word "CARBON" composed of approximately 2 million carbon nanotubes.

The writing was defined by electron-beam lithography and the carbon nanotubes grown by thermal chemical vapour deposition. The area shown is approximately 500 μm by 600 μm . The inset shows the side view of carbon nanotubes at higher magnification.

Bernhard Christian Bayer, Christoph Tobias Wirth & Stephan Hofmann
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Mapping of thermal strains within the microstructure of Gilsocarbon nuclear graphite. Digital image correlation has been applied to 3-dimensional high resolution tomography scans obtained at the Swiss Light Source between temperatures of 270K and 150K. Higher thermal strains are associated with local variations in crystal orientation and the effects of local porosity on constraint. These data are being used to verify microstructure-based models for thermal and irradiation induced dimensional change.

David James (University of Manchester)

Transmission electron microscopy image a binder microstructure in Gilsocarbon nuclear graphite. Quinoline insoluble (QI) particles with a size of ~ 200 nm, can be observed. Well-graphitized crystallites (G) with different orientations are observed between these QI particles. Finer features with a nanosized structure can also be observed.

Keyun Wen (University of Manchester)

Neutron Activated Graphite: Autoradiographic image of neutron activated graphite from the British Experimental Pile Zero (BEPO) nuclear reactor core. The core was operational from 1948-1968 with a final decommissioning date scheduled for 2022. Autoradiography produces a visual distribution pattern of radiation, where the specimen is the source of the radiation. Autoradiography therefore provides information on the distribution of radioactivity within a sample. This information is being used to understand how thermal and leaching treatments may reduce the activity of nuclear graphite waste. The area of this autoradiography image is 6 x 9 mm. Hot (i.e. red) colours indicate higher activity.

Lorraine McDermott

Carbon Nanoforms: This image shows the creation of carbon 'peapod' nanotubes, an experiment performed regularly in the Materials Department at Oxford. C60 'buckyballs' are sucked inside the tubes by the van der Waals force. The buckyballs have an additional nitrogen atom in their core. The quantum 'spin' associated with this atom may offer a means to store information in future technologies. Here we see six nanotubes winding around one another to form a 'nanorope'. This rope will be unravelled in a later experiment so that individual nanotubes can be deposited onto a surface and connected to metal electrodes.

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The Fullerenes: The path that was to lead to the discovery of the Fullerenes, including C60, famously began with an investigation into the possibility of clusters forming from interstellar Carbon. This image juxtaposes the "Magic Sequence" Fullerenes (C24, C28, C32, C50, C60 and C70) as predicted theoretically by Kroto¹ and observed experimentally by Cox *et al*², against a striking image of the Helix Nebular produced by the Hubble space telescope.

¹ H W Kroto, *Nature* 329, 529 (1987)

2 D M Cox, K C Reichmann, A Kaldor, *J. Am. Chem. Soc.* 110,1588, (1988)

Calvin Davidson (University of Sussex)

The Space Elevator: The basic idea central to a space elevator, or orbital tower, was first discussed by Konstantin Tsiolkovsky in 1895 and the concept was examined in more detail by Yuri Artsutanov in 1959. However, most observers would credit Sir Arthur C Clarke, who passed away this year, with the idea's introduction into popular culture in his 1979 novel, "The Fountains of Paradise". Here, a bundle of carbon nanotubes rises to orbit from the Maldives, the closest equatorial location to his adopted homeland of Sri Lanka as a homage to the great man's vision.

Calvin Davidson (University of Sussex)

AGM and Capital Carbon Meeting 2008

The Group's AGM and the now well-associated Capital Carbon meeting took place on December 16th 2008 at the Institute of Physics. Gareth Neighbour and Nicole Grobert offered themselves for re-election to the Chair and Vice-Chair and were confirmed in these positions with acclamation. John Fisher has been our secretary for the past four years and his term of office having expired, Peter Minshall was proposed and duly elected in his place. Gareth thanked John for his sterling efforts over this period but remarked that we would not be losing his services on the committee, as he was immediately appointed SCI representative. Mark Thomas had likewise to stand down from the committee but has expressed his willingness to be co-opted.

Our Treasurer, Tony Wickham, was unable to be present but left a statement of accounts, which showed us to be in a very healthy state financially. During his Chairman's address, Gareth said how pleased we were that the RSC had given Tony a long service award for his work for the Society, both with the BGC and as current Chairman of the mid-Wales section of the RSC. He went on to say that we had had another highly successful year, with NanoteC08 being of its usual high standard while the meeting organised in November by the Group and supported by the nuclear industry on "Securing the safe performance of Graphite Cores" had equalled the success of its predecessors, attracting over 100 delegates. The present meeting, "Capital Carbon" would, he was sure, be just as successful as the previous two.

During the year, the Group had organised a photographic competition, "Capturing Carbon" and this had attracted 14 very good entries, which appear elsewhere in this newsletter. Out of a very competitive field the selection committee had chosen the entry by Carl Davidson of Sussex University. Gareth presented him with a framed certificate in recognition of his achievement. At the same time, he presented Malcolm Heggie, our immediate past-Chairman, with a certificate recording his long and important services to the Group.

We then moved on to the Capital Carbon meeting, the keynote contribution being the delivery of the 2nd Ubbelohde Lecture by Prof. Steve Tennison. During his fascinating talk, Steve referred to the fact that during his time at BP, he had received valuable advice from Prof. Ubbelohde, who was a consultant to the company, and this was a very happy connection with the award of the lectureship. Steve said that his experience of working in the field of carbon extended back nearly 40 years and he took us through a history of the projects, many successful, some not, that he had been involved in. The ability to characterise the carbon surface in some detail and hence, to optimise its performance, had led BP to the development of a successful catalyst for ammonia synthesis, using caesium-promoted ruthenium on a high surface area graphite support, the process reaching a

commercial scale in 1996, some 25 years and much research expenditure later. (As a former catalyst man myself, I note somewhat wryly that it has taken almost 90 years to find an effective substitute for the old original magnetite catalyst of the Haber-Bosch process).

His other main theme was the development of carbon monoliths derived from phenolic resins. Pyrolysis of these resins enables one to get a microporous carbon of very well-defined nanopore structure with a very narrow pore size distribution. At the same time, the resins can be made to give carbons of pronounced mesopore structure and having considerable mechanical strength. This had led them to a variety of applications. He emphasised that the aim of his present company, MAST, was to target high value applications as opposed to the mass market, like for example, water treatment that uses enormous amounts of relatively cheap active carbons. The mesocarbon beads can have important medical applications and he cited in situ treatment of blood to remove harmful proteins, a process shortly undergoing animal trials.

The monoliths could have enormous rates of uptake of volatile compounds. For example, n-hexane at high concentrations could be removed quantitatively from air streams flowing through the channels at high space velocities despite the fact that you can actually see through the channels from end to end.

At the end of his lecture Steve answered questions and was then presented with a framed certificate to acknowledge his acceptance of the Ubbelohde lectureship.

John Hutchinson from Oxford then gave an account of his 40 years' involvement with carbon research. This started in Glasgow with a Philips electron microscope in the 1960s. He showed a picture of this venerable machine, which had on the pedestal three skull and crossbones. John said that this was to warn him to keep himself out of the way of the 75kV power supply but I wondered irreverently if it represented the number of graduate students who had prematurely gone to meet their Maker as a result of contact with this machine! He culminated his talk by showing the latest EM pictures of nanotubes where the atomic structure can be seen quite clearly.

He was followed by Mhairi Gass of the SuperSTEM facility at Daresbury. There are two of these instruments and are available to all researchers in the UK for projects that cannot be undertaken on other machines. Besides the high resolution STEM capacity, they also have EELS to analyse amongst other things the π - π^* transition in different carbons. (I had to do a mental gearchange here: my previous experience of EELS was in surface science applications where one deals in meV, as the transitions are in the vibrational part of the spectrum. Here, Mhairi was dealing with 3 orders of magnitude greater, 5-6eV). The value of this extra technique was shown in examining diamond, where this transition was observed, showing that there are some at least sp^2 carbon atoms in among the sp^3 matrix. It also showed its value when examining graphene sheets, as the peak moves from 5→6eV, according to the number of graphene layers, giving confirmation to the values derived from the STEM images.

The last talk came from Jon Goss, who examined the potential of diamond as a material in future electronics. Despite its high thermal conductivity, it is normally an insulator because of the large band gap between the valence and the potential conduction bands. It could in principle be converted into a semi-conductor by suitable doping with impurity ions and species but success so far has been elusive. The doping is normally done by CVD in a plasma discharge, which gives opportunity to insert a range of species like S, B or P. He

examined the theory underlying the different candidate species. Co-doping may be a way forward towards reducing the band gap to 0.4 eV.

Finally, he discussed the phenomenon of surface conductivity of diamond, a well-established phenomenon and one where the conductivity can be increased by anchoring or tethering various surface species.

The meeting was well up to the high standard set by its predecessors. The only disappointment was the relatively small turnout of members. The IOP is an excellent venue, with good access and beautifully decorated meeting rooms. Not only that, but we got a very good hot buffet lunch and a glass of wine. I strongly recommend your making a note to book ahead at mid-December 2009 for the next in the series.

Norman Parkyns



Pictures taken at the Capital Carbon meeting, December 2009 at the IOP. Top left, Prof Steve Tennison receives a certificate commemorating his delivery of the 2nd Ubbelohde lecture from the BCG Chairman, Dr. Gareth Neighbour. Top right, the winner of the “Capturing Carbon” competition, Carl Davidson, University of Sussex, receives his certificate. Below, Past-Chair Malcolm Heggie receives his award from his successor.

INGSM-11

The next meeting in the series of International Nuclear Graphite Specialists, which the BCG is co-sponsoring as it has done for previous meetings in the UK, is announced for September 12-15th at Eastbourne. Full details can be obtained from the organiser Dr. Tony Wickham confer@globalnet.co.uk

Chris Ewels, Euroscientist

Chris Ewels, who is an active member of the BCG committee and who has gladdened this editor's heart many times by contributing to the newsletter, has recently been the subject of a feature that appeared in an EU publication, *research*eu* n°58, December 2008. Under the heading “*Un chercheur dans le vent*” (a researcher in the wind—I must have missed the sense of something here!), there is an extensive account of Chris' scientific career and his movements around Europe. It's rather too long (and all in French) to repeat it here but those interested can look it up. There is quite an emphasis on the work of the Vega Science Trust in communicating and popularising scientific research to the general, non-scientific public and of course to schoolchildren, and in particular, Chris' own part in it.

Carbon 2009

A student's account

Espace Bellevue & Casino Municipal. Biarritz, France, 14th – 19th June 2009

I'm certain that most readers of this newsletter will be very well aware of the Annual World Conference on Carbon, but for those who don't here is a quick outline. The conference is an annual event incorporating all areas of carbon science, from nano scale to macro. Since the year 2000 Carbon has been alternately held in Europe, America and Asia. It provides an opportunity for individuals and groups from both academia and industry to discuss their work and enhance their knowledge of other Carbon related topics. Carbon 2009 attracted in excess of 600 attendees from many countries around the globe. This clearly demonstrates the international commitment to carbon research and I'm sure it has nothing to do with it being held adjacent to a sandy beach with an excellent surf!

As a postgraduate student heading to their first international conference, I was unsure what to expect. My PhD is focused primarily on the modelling of mechanical properties and fractography of industrial graphites. With carbon being such a unique element and having a huge variety of applications I was sceptical as to how much of the information being presented would be relevant to my research. As expected there were only a few presentations focusing on my subject area. However, I was able to gain a better understanding of general research methodology as well as ideas for experimental processes and applications, which I am sure, will prove to be very beneficial over the coming years.

Nanotubes were certainly very popular throughout the first few days, as well as carbon fibres. Many of the talks I attended focused on mechanical properties and manufacture of materials, which made it possible for me to follow most of the information being presented. As an engineer, chemistry is definitely not my strongest area. I did attempt to avoid any chemistry-heavy talks but inevitably I found myself looking at double bonds and carboxyl groups with blurred vision! Admittedly most of it did go over my head but I did pick up a few points. One research area which I found particularly interesting was the manufacture of carbon foams from the pyrolysis of polymers. Having some previous knowledge of this process, it was fascinating to learn about this in greater depth.

Of course, conferences aren't all about the science; there is also the social side to it. Being in the Basque region of south France, we were given the opportunity to experience some of the local culture. Traditional sports were demonstrated and we were treated to Basque singers during the conference banquet which was held in a rustic barn setting. All of which made for a very enjoyable and memorable evening.

My presentation was scheduled for the Friday morning, the last day of the conference. Admittedly not the best presentation slot but I'm not one to complain! I was talking about

biaxial testing and its applicability to brittle materials, primarily industrial graphites. The talk itself went well and resulted in a few interesting discussions during the next coffee break, including one about the merits of various test methods with a representative of SGL carbon.

Overall the conference was very enjoyable and a great experience. It was certainly successful in broadening my knowledge of numerous carbon science areas. I would like to thank wholeheartedly the British Carbon Group for their support in allowing me to attend this conference.

Gary Kipling

Diamond days—RSC Chemistry news

We have been trying to raise the profile as the saying goes these days, of the BCG among RSC members generally. Our membership from the IOP and the SCI has increased quite substantially recently, whereas the RSC membership has remained rather static. Ian Mc Neish, the editor of Chemistry News was very enthusiastic when I suggested doing a piece on the Group and he did us proud by giving a very good spread in the February 2009 issue. RSC members should already have seen this but I thought that I'd bring it to the attention of those from the IOP and SCI. Ian really did us proud and produced a most eye-catching article from the information I gave him. I had hoped to reproduce it here but unfortunately, in an A5 format, the text would be all but unreadable. Should anyone want to look at it, please contact me at norman.parkyns@tesco.net and I'll send it on in pdf format.

Publications received

I have received notice of a number of publications that may be of interest to members. Among them, Dr D. Millward of the British Geological Survey has sent me copies of two papers he has published with some Spanish colleagues of the nature of the Borrowdale graphite in Cumbria. I give just the titles below: anyone interested in following them up can contact Dr. Millward at dmill@bgs.ac.uk

1. Deposition of highly crystalline graphite from moderate-temperature fluids
F.J. Luque, L. Ortega, J.F. Barrenechea, D. Millward, O. Beyssac, J-M. Huizenga

2. Graphite morphologies from the Borrowdale deposit (NW England, UK):
Raman and SIMS data
J. F. Barrenechea F. J. Luque D. Millward L. Ortega O. Beyssac M. Rodas

New nanotube book:

I've also had a message from Dr. Peter J. F. Harris to say that he has just had a book on nanotubes published. The publisher's notes on the book are given below.
"A new version of Peter Harris's book on carbon nanotubes has just been published by Cambridge University Press. Entitled "**Carbon Nanotube Science**", it is based on Peter's earlier book, "Carbon Nanotubes and Related Structures", but focuses solely on nanotubes. It is fully updated to cover the literature to 2008, with a number of completely new chapters. Further details, including a contents list and a facility for viewing inside the book, can be found by going to the CUP website at <http://www.cup.cam.ac.uk/> and searching for "Nanotube".

Political Thoughts on Carbon Capture and Sequestration

This allegedly new technology is now highly popular among people concerned with 'global warming' and how to prevent it. This enthusiasm has led to an 'unholy' alliance of interest directed against consumer and taxpayer, in other words to a global effort at generating a transfer of resources, broadly interpreted, from government to this alliance.

As governments in 'the West' no longer own much that actually creates wealth, they have to rely on the wealth creators, business, to do so. The tools for extracting money for investments are numerous, ranging from taxes to regulations, from the setting of emission standards, to the handing out financial incentives and direct grants, from emission trading schemes to risk insurance. Effectively, society pays the wealth creators.

Carbon capture and sequestration, assuming that it can be done at the huge scale that is allegedly required for mitigating global warming (such as saturating entire geological formation like basalt shields with the gas) in the hope that it stays there forever in some form or other, is being experimented with in many places, with Australia, Germany and the USA possibly in the lead. One company in Scotland tried to get state subsidies for CO₂ injection only last year, but government found the required sum too large. The capture of carbon can be done, but the cost of this effort depends on the purity of the captured gas, likely to have to be transformed into a liquid (with much energy) for injection into one of a range of geological formations, and the purpose of the exercise. Simply removing a gas at great cost from the atmosphere where it is present as trace gas the effect of which remains, in my opinion, poorly understood.

Yet the idea has many supporters. Who currently support the idea?

There is the geology research fraternity. A few years ago I met a group of them in Australia, all climate sceptics, as used to be natural for geologists familiar with climate change throughout history, including human history. This was no longer the case, at least in public. A major global research agenda is being funded with reference to CCS, expanding research in many geological areas, from the study of carbonisation, faulting, groundwater movements and much more. I have heard sceptical remarks about the long term feasibility of this waste disposal mentioned, but it is clearly too early to be sure.

Others, for example the coal industry, are attracted to the idea as a possible salvation. To be achievable, a high price for carbon dioxide will be needed (and hence higher energy prices). Clean coal advocates cannot but jump on the bandwagon provided the support, at least in public, Al Gore and his ilk, which seems to include the entire British Cabinet and almost all the political parties. And who knows, clean coal may have to survive thus provided our government, and especially the EU Commission hold fast on their belief that they can lead the world in 'combating climate change' or even saving the planet. How much longer can they afford this game?

Even more than the coal industry, the oil and gas people are attracted to the idea. What comes as a potential cost to the coal people, might become a bonus. They might even obtain the gas for free in order to inject into depleting or difficult oil and gas fields. For them the injection technology is old hat, though used only in some places. When I questioned Middle Eastern oil producers on the issue of global warming, they showed little concern but shrugged and smiled: 'we just pump it back to get out more and have been doing for a long time'.

And then there are the environmentalists, who being puritans, scientifically illiterate in many cases and ideologically committed to believe in man-made catastrophe. They do not like the idea and are responsible for CCS still not having been accepted as a method for emission reduction under the Kyoto Protocol. What they oppose is of course the use of the carbon dioxide to assist the oil, gas and coal industries. (Being also opposed to nuclear power, they can be regarded as enemies of the people by now). They want to change human aspirations

and behaviour so that ‘the planet may be saved’, or rather that any opposition to higher taxes and prices, i.e. that a transfer of resources to the ‘winners’, is not resisted by popular opposition. Are they really playing a double game?

That leaves the governments, torn between conflicting forces. Here a distinction needs to be made between those that have too much carbon dioxide for their liking (or targets foolishly agreed) and those that remain unencumbered by the need or desire for emission reduction. A distinction must also be made, and an increasingly important one, between those that still possess large amounts of carbon fuels, fossil or otherwise, and those that have peaked or are increasingly dependent on imported conventional fuels. Carbon fuel rich countries, from observation, are less keen to give ‘carbon’ a price and set up emission trading schemes. Buying emissions from abroad may cost more than importing goods made in countries without strict emission controls, so carbon leakage is something that CCS might address.

Some countries and industries have carbon dioxide to sell and may therefore earn from the trading systems now available in Europe and under the CDM, one of the Kyoto Mechanisms, though here the battle for the acceptance of CCS as one means for ‘reducing’ carbon emissions continues. More important than individual states as supporters of CCS are intergovernmental bodies without direct responsibility for supplying energy to real people, namely the Commission of the EU and various UN bodies, including the World Bank. Interested in finance and regulatory power (and jobs) they see carbon trading and CCS as a positive step, not for themselves of course, but to help the poor and save the planet.

So the CCS debate remains a highly political one in which the interests of the few and powerful seems to prevail. Politics has always been the art of persuasion. The old threat of a changing climate, no longer supported not by biblical prophecies but by computer model predictions— rapidly rising sea levels, more hurricanes, scorching summers, floods and hail storms, and worse – still in the end serves the making money and achieving societal control.

And yet... money needs to be saved and society has to be controlled. Capital has to be accumulated for the future and investments in new technologies have to be funded from current wealth. The punishment for spending the future in advance, may be facing us just now. The transfer of capital (and energy) from rich to poor may be urgently needed, provided of course..... And science has always been a handmaiden of politics. Or? CCS can be considered a foolish pipedream or a forgivable lie to achieve a better future. I personally doubt that it will become reality at the scale allegedly required to stop ‘global warming’. Humanity can’t control the climate, but the whole world may need to find substitutes for carbon fuels. But why the hurry?

Sonja Boehmer-Christiansen, Hull University, September 2008.