

Editorial

First of all, may I draw your attention to the AGM on December 16th, a formal notice of which is included in this newsletter. As we have done for the past few years, this will take place during a meeting of general interest in the field of carbon, with talks by leading researchers on the advances in their areas of special interest. These meetings have been enjoyable, being both very lively and well-attended, so please make a note in your diary now. The minutes of the AGM are included in this newsletter, so will not be distributed during the meeting. If you have points to raise or corrections to be requested, please bear this in mind.

One issue that has been debated more and more in the media has of course, been that of climate change and the potential contribution of CO₂ to it. The phrase “Carbon footprint” is now almost a cliché. Your committee has obviously thought deeply about whether this constitutes something that we as a community should take deeper consideration of. Although the problem is that of CO₂ rather than elemental carbon, quite a large proportion of it comes from burning solid carbonaceous fuels. Coal technology has always been an area where our members have made considerable contributions and indeed, many of them still speak with authority on it. We think therefore, that this should be reflected in our activities and contributions about the environmental impact of the use of carbon on energy production will be welcomed in this newsletter. As a start, Prof. Harry Marsh has published his feelings on the matter, all the more deeply felt because he spent his life in coal and carbon research. I hope that you will send in other contributions, personal opinions being welcome, so I invite any of our members who would like to air their thoughts to send them to me. Like all editors, I’m happy to publish anything that is not clearly nonsensical or actionable.

The meeting on Ageing Nuclear Reactors will have taken place by the time you read this but the previous one in this series, organised as is this by Tony Wickham, was very successful and I am sure that this will build on that success. As I said above, our next general meeting takes place around the AGM: the past two have been excellent, with a good attendance and lively keynote speakers, outlining the advances and the current state of research in their field. This year, we are following the same pattern, so you will be well-advised to come to Portland Place in December.

The spring meeting is now in an advanced state of planning. A preliminary notice appears elsewhere in this newsletter. I am also including a notice for Carbon 09, as many of you will wish to go but it looks as though I might have missed the deadline for submission of abstracts. In my defence, I have to say that I only received this some weeks ago.

The European Carbon Association (ECA), of which we are of course active members, has announced nominations for an award for a member of the carbon community deemed to have made a major contribution. Full details are given in the notice in this newsletter.

As far as past meetings go, I am indebted to Irene Suarez-Martinez for a somewhat unconventional, highly idiosyncratic but lively and informative account of NanoteC08. I understand that NanoteC09 may go wandering off to Belgium this year, so keep your eyes open. Chris Ewels and his cohorts are on the case. I’m pleased also to be able to include a student report for a meeting in Spain. We do support students to attend appropriate meetings but they have to sing for their supper so to speak, and a report to be published in the newsletter is a condition of the award. Still, I’m grateful to Mike Dowling for giving us such a lively one.

Finally, I have just been told that Tony Wickham has received an award from the RSC for his services. I’m sure he will deprecate anything serious in this but the rest of us will heartily congratulate him on this well-deserved honour.

Norman Parkyn *norman.parkyn@tesco.net*

The British Carbon Group

Notice of 2008 Annual General Meeting

Notice is hereby given that the 2008 Annual General Meeting of the British Carbon Group will be held at the start of the Capital Carbon Annual Christmas half day meeting on Tuesday 16th. December 2008 at 1.00 pm.

The venue is The Rutherford Lecture Theatre, Institute of Physics, 76 Portland Place, London W1B 1NT.

The business of the Meeting is as follows: -

1. Apologies for Absence
2. Minutes of the previous AGM (Held at The Institute of Physics, London, 18th. December 2007).
3. Matters Arising
4. Chairman's Report
5. Treasurer's Report
6. To Receive Notice of the Representatives of the Sponsoring Bodies
7. Election of Officers and committee members.
8. Any Other Business

At the 2008 AGM the Chairman and Vice Chairman must retire and offer themselves for re-election. Nominations for these positions are invited. In addition the positions of Honorary Secretary and one ordinary Committee member fall vacant this year and nominations for these two positions are also invited.

Nominations duly proposed and seconded and with the consent of the nominee, should be received by the Honorary Secretary before 1st. December 2008 at the following address: -

Dr. J. Fisher
7 Blake Close,
Rotherham,
S66 1UN

e-mail john.fisher1@btconnect.com

THE BRITISH CARBON GROUP

MINUTES OF THE 2007 ANNUAL GENERAL MEETING HELD AT THE INSTITUTE OF PHYSICS,
PORTLAND PLACE, LONDON, 18th. DECEMBER 2007 AT 3.00 pm

PRESENT: Professor M.I. Heggie (Chairman), Professor J. W. Patrick (Vice Chairman), Dr. A.J. Wickham (Hon. Treasurer), Dr. J. Fisher (Hon. Secretary) 7 committee members, plus 13 members.

APOLOGIES FOR ABSENCE:

Apologies for absence were received from:

Professor H. Marsh, Professor B. McEnaney, Dr. R. Daley, Dr. J. Goss, Dr. N. Grobert

MINUTES OF THE PREVIOUS MEETING

The minutes of the previous AGM, held on the 19th July 2006 at the Robert Gordon University, Aberdeen were approved as a true record.

ACTIONS AND MATTERS ARISING (not covered in Agenda)

There were no matters arising.

CHAIRMAN'S REPORT (Professor M.I. Heggie)

Following the very successful and time consuming, C2006 meeting in Aberdeen the BCG did not organise a Spring meeting in 2007.

Our annual conference, NanoteC'07 was held in its traditional home, The University of Sussex, Brighton in August (www.hpc.sussex.ac.uk/nanotec). This meeting was, as usual, well supported and successful, with lively discussions taking place. There were over 90 participants, from the UK and overseas. Indeed the international standing of the conference was confirmed by the attendance of four distinguished professors from Japan and one from the USA. The Chairman expressed his thanks to Greg Van Lier, Nicole Grobert and Chris Ewels for their hard work during the organisation of the conference and to Tony Wickham for his efficient administration before and during the conference.

Many BCG members attended the annual International Carbon Conference this year. C2007 was held in Seattle and at this conference the BCG administered Brian Kelly prize was awarded to Philip Adelhalm of the Max-Planck Institute of Colloids and Interfaces, Potsdam, Germany.

This year's AGM was being held during an afternoon meeting entitled "Capital Carbon". This meeting was well attended with 5 speakers bringing the Carbon community up to date with the developments in current "hot topics".

He also put on record his appreciation of the generous collaboration that he had experienced from the committee. In his period of office he had Chaired two NanoteC meetings, two Christmas meetings such as this one, and the International Carbon Conference held in Aberdeen in 2006. The pronounced success of these meetings was due to the substantial efforts of the committee as a whole. Well done!

The Chairman expressed his thanks to the retiring Vice-Chairman Professor John Patrick for his hard work and support during his 4 years in office.

Secretary's note:

Following the Chairman's report the meeting expressed its thanks to the outgoing Chairman Professor Heggie for his 4 year term of office.

TREASURER'S REPORT

The final report for the calendar year 2006 was presented by the previous Honorary Treasurer, Dr. C.J. Hindmarsh. The year was considered financially successful with a "throughput" in excess of £250,000 due to the C2006 conference and a year end balance of £44,730.

The Chairman pointed out that cycle for running the International Carbon conference was likely to be extended beyond the traditional 10 year cycle due to additional country groups wishing to organise the meeting. This bank balance would need to fund BCG activity through the period between UK organised International Carbon conferences.

ELECTION OF OFFICERS AND COMMITTEE MEMBERS

At this the 2007 AGM the Chairman and Vice Chairman had to stand down and under our constitution were not allowed to offer themselves for re-election.

In addition three committee posts became vacant at the 2007 AGM.

Prior to the AGM the following had been proposed and seconded for the vacant positions:

Officers:

Chairman: Dr. Gareth Neighbour (University of Hull)
Vice Chairman: Dr. Nicole Grobert (University of Oxford)

Committee Members:

Dr. J. Andresen (University of Nottingham)
Dr. A. Fletcher (University of Newcastle upon Tyne).
Professor S. Mikhalovsky (University of Brighton)

All the above nominees were elected unanimously by the meeting to the positions detailed.

The following were notified as representatives of the sponsoring bodies:

SCI representative Dr. J. Fisher
RSC representative Dr. A.J. Wickham
IOP representative Dr. J. Goss

The meeting was also informed of the committees' intention to co-opt Dr. Peter Minshall onto the committee.

Any Other Business

There being no other business previously notified the meeting was closed at 3.30 p.m.

Confirmed as a true record.

Malcolm Heggie (BCG retiring chairman)
John Fisher (BCG Honorary Secretary)

Award for Dr. A. J. Wickham

The RSC has just announced an award to Tony Wickham for his services to the Society through his many years' activity in the Faraday Division and specifically for his work for the British Carbon Group. He is also Chairman of the Mid Wales Section of the RSC. Besides being current Treasurer of the BCG, he is a past Chairman and played a leading role in setting it up some 15 years ago by merging the then two separate Carbon Groups of the SCI on the one hand and the RSC/IOP on the other. I suspect that he drew up the constitution himself and has always vigorously upheld the independence of the Group against encroachment from what ever outside body. He has, through his consultancy firm, helped us to put on a number of highly successful conferences, including the NanoteC series and culminating in Carbon 2006, which was a great success in all aspects: all this, and at the same time being a highly sought-after consultant on all matters pertaining to nuclear graphite.

I am sure that Tony will not wish me to make him blush by extolling his virtues further but I can assure him that all his colleagues are delighted by this expression of the value of his work.

Norman Parkyns

16th December 2008

13:30pm

Venue
Rutherford Lecture Theatre
Institute of Physics
London

Registration

[http://www.britishcarbon.org/pdfs/](http://www.britishcarbon.org/pdfs/CapCarb.pdf)

CapCarb.pdf

**BRITISH CARBON GROUP CHRISTMAS MEETING
AGM & 'CAPITAL CARBON'**



The British Carbon Group



A half day meeting will be held on Tuesday 16th December at the IOP in London devoted to latest developments, future prospects and cross-fertilization between three principal domains of carbon research: diamond, graphite and nanocarbons.

12.30 Buffet Lunch

13.00 AGM for BCG members

13.30 Welcome - Dr Gareth Neighbour
Chairman of BCG & University of Hull

13.35 The 2nd Ubbelohde Memorial Lecture
Prof Steve Tennison, MAST Carbon
*Nanoporous carbon—past, present and future:
a personal view*

14.15 Awards (including winners of the 'Capturing Carbon' competition)

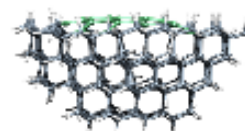
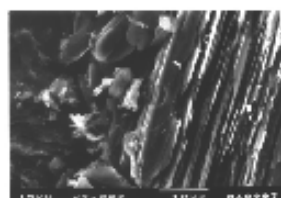
14.25 Dr John Hutchinson (University of Oxford)
Forty Years Looking at Carbon

15.05 Tea & Coffee

15.35 Dr Mhairi Gass (superSTEM)
Understanding carbon nanostructures on the atomic scale

16.15 Dr Jonathan Goss (University of Newcastle)
Diamond

16.55 Meeting Close



The British Carbon Group (registered charity 207890) is affiliated to The Royal Society of Chemistry, The Institute of Physics and The Society of Chemical Industry.




RSC Advancing the
Chemical Sciences **IOP** Institute of Physics

BCG spring meeting 2009 Call for papers

31st March 2009
1st April 2009
Venue
Manchester Conference
Centre, Weston Building

Registration
<http://www.britishcarbon.org/spring2009>



BRITISH CARBON GROUP SPRING MEETING

CARBON IN HEALTH, THE ENVIRONMENT AND ENERGY

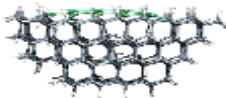
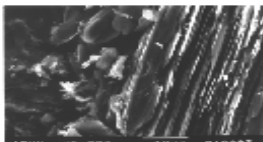
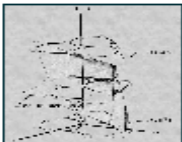
The British Carbon Group

FIRST ANNOUNCEMENT & CALL FOR PAPERS



The 'Carbon in Health, the Environment and Energy' is a two day meeting that aims create a strong multi-disciplinary discussion centred around carbon science. The prominence of carbon science in today's society is immense especially with issues such as global warming and environmental emissions from the combustion of fossil fuels. Nevertheless, many of the solutions rest with advancing our understanding of carbon science, development of new carbon materials such as nanocarbons and how these might have an effect upon the health of the population and the wider environment. This meeting provides an excellent opportunity for cross fertilization of ideas and knowledge from many fields with a strong interest in carbon science. Papers are invited from any aspect of carbon science in the health, the environment and energy. Sessions within the meeting will be organised along these lines with invited speakers on topics related to carbon emissions from combustion, biological effects of carbon and nanocarbon materials and predicting the role of carbon in the energy markets.

Intending authors should submit an abstract of a minimum of 100 words in length and no later than the 28th February 2009. The format, layout and content of the abstract should be simple and informal to aid reproduction to a common structure and format in an edited programme.

Abstracts should be submitted to g.b.neighbour@hull.ac.uk. If you have any doubts about whether your contribution fits into the conference scope, please email for advice enclosing a short abstract. The conference organisers will endeavour to respond quickly indicating the suitability of the paper.



The British Carbon Group (registered charity 207890) is affiliated to The Royal Society of Chemistry, The Institute of Physics and The Society of Chemical Industry.

RSC | Advancing the
Chemical Sciences Institute of Physics

ECA Award 2009

The European Carbon Association (ECA) is pleased to announce a new award to recognise a significant contribution to the European carbon science community carried-out by a scientist from anywhere in the world, or a remarkable service to the worldwide carbon community carried-out by

a scientist from Europe. The ECA Award will be presented at each World Carbon Conference organized by one of the national carbon groups of the ECA.

The award will be made on the recommendation of the ECA Award Committee and seeks to honour “Remarkable service to carbon science community” with the recipient holding the respect of their colleagues and “having been influential and supportive towards others in the pursuit of scientific excellence or have made a significant contribution in providing a strong foundation to the community of carbon scientists and technologists in order to promote a flourishing and healthy environment for scientific achievement”.

The ECA award includes a prize of 1000 Euros.

Nominations are now sought for the award. The nomination should be made without the knowledge of the potential recipient and include a citation of 200 to 250 words.

Nominations should be sent to the current Chair of ECA, Dr. Rosa Menendez
rosmenen@orgc.csic.es

The closing date for nominations for the ECA Award will be **30th April, 2009**.

Emission, Capture and Sequestration of Carbon Dioxide

Harry Marsh

*No matter how carbon dioxide in the atmosphere affects Planet Earth it is imperative to recognise the global magnitude of amounts emitted and sequestered where all who are concerned use the same units of mass.
How about a mass-balance sheet? Think big!*

Emissions: Dumbing Down

In his article “Carbon Capture and Storage” (Carbon Newsletter No 35, Jan 2008) Norman Parkyns expressed the need for a transparent mechanism for encouraging carbon dioxide removal on a World-wide basis. His article expressed the frustration at this lack of transparency. Time and time again, the media emphasise the need for control over extents of emissions of carbon dioxide into the atmosphere. Time and time again, the problem is dumbed down with suggested mechanisms which would have almost zero effects on extents of emissions. The media appear to be unable to

grasp the magnitude of the problem facing this planet. Of the several reasons for this one is the number of different and confusing units used to describe extents of emissions and sequestration. A second reason relates to time scales (geological) of events and the enormity of amounts of carbon dioxide emitted. A third reason may be the politician.

I see it locally.

A local insight into the problem can be seen from my lounge window which faces the river Tyne. Each week, two vessels arrive from Poland or Russia carrying about 30,000 tonnes of coal to feed northern power-stations. Each week, these two vessels leave the Tyne empty or in ballast, but eventually leaving behind in our atmosphere (all of it) about 200,000 tonnes of carbon dioxide. No technology is in place to capture, on a local basis, these 200,000 tonnes each and every week. Globally, **5Mt** of coal are combusted, putting **~15Mt** of carbon dioxide into the atmosphere. The media never mention this.

Each week, from my lounge window I see a daily procession of car transporter ships carrying vehicles from the Nissan car factory at Sunderland to Eastern Europe and the Far East, part of the annual production of 400,000 units. All these vehicles will have carbon dioxide emissions. No government official has stated that vehicle production must be reduced. Rather, the benefits to the local economy of the presence of Nissan are boosted. Who can deny this?

Let us talk the same language.

The favourite unit of quantity of the politician is the “percentage”. To the scientist, this unit is the road to ambiguity. As the problem of carbon dioxide emissions is a problem of Planet Earth, then all data must relate to the size of the planet and be in fundamental units, such as mass. Forget about trillions and pounds. We must use the Teratonne (**Tt**), equal to 10^3 Gigat (**Gt**), equal to 10^6 Megat (**Mt**), equal to 10^{12} tonne. To illustrate the point, the mass of the atmosphere is 5,100 **Tt**. A common unit for amounts of carbon dioxide in the atmosphere is ‘ppm(m)’ or ‘ppm(v)’, a unit of indication, more qualitative than quantitative in nature. A current estimate of carbon dioxide in the atmosphere is about 600 ppm(m), which amounts to about 3 **Tt**. The

amount of carbon dioxide released into the atmosphere during 2007, from all sources, amounts to ~30 **Gt***. This number can now be related directly to efforts of emission reduction and sequestration. To stabilise amounts of carbon dioxide in the atmosphere would require a permanent reduction in emissions of 1 **Gt y⁻¹**, increasing by 1 **Gt y⁻¹** for the foreseeable future, noting the major energy expansion programmes, as in China, and other developing countries.

*There is a need to prepare and use, internationally, a comprehensive **mass-balance sheet** for, on the one hand, estimated emissions world-wide, and on the other hand, estimated, planned and achieved reductions, including sequestrations, in emissions. Hopefully, such an approach may prevent fragmentation and duplication of research efforts. This may be a project for the IEA who could publish these **mass-balance sheets** in their 'Greenhouse Issues', and also via appropriate news releases to a much wider audience.*

*Total emissions of carbon dioxide can only be estimates calculated from carbon contents of mainly coal, gas, oil which are combusted. Emissions from humans and animals amount to less than 0.3 Gt (<1 %).

Constructive Comments?

Geological evidence is thrust upon us that the increase in carbon dioxide content of the atmosphere is a totally natural phenomenon running in cycles. A major rise in atmospheric carbon dioxide to 5 wt % (250 **Tt**), about 300 millions ago occurred at a rate of 5 wt % over 50 million years. This translates into ~5 **Mt** per year. This compares with 30 **Gt** released into the atmosphere in 2007, an increase in rate of 5,000 times, currently. On the geological plot, current increases in carbon dioxide content would be a very thin vertical line.

The development of the Integrated Gasification Combined Cycle (IGCC) in association with fuel cells is of emotional appeal to the political platform. But will it really solve any of our problems? Their use will not reduce the demand for coal; it would only augment supplies of electrical power to an exploding population.

Bright ideas from Universities may not be that bright. I read that activated carbon, with a surface area of say $1,000 \text{ m}^2 \text{ g}^{-1}$, can be used effectively to adsorb carbon dioxide in power station emissions to mitigate global warming. Sounds like a great idea until the scale of operation is worked out. A conventional power-station, coal burning, of 500 MW capacity, burns 100,000 tonnes of coal per day, producing 300,000 tonnes of carbon dioxide per day, continuously. Activated carbons can adsorb a maximum of about 0.2 t t^{-1} needing about 60,000 tonnes of activated carbon **per hour**, continuously, for just one power station. The production of activated carbon on this scale, the controlled capture, desorption, transportation and sequestration of carbon dioxide are not even mentioned, certainly not discussed.

There is a suggestion that conversion of carbon dioxide to cyclic carbonates could make a pretty good contribution to control of carbon dioxide emissions using **48 Mt** y^{-1} . In 2008, worldwide emissions of carbon dioxide approach **30 Gt** y^{-1} of which **1 Gt** (~3 wt %) originates from the UK. The impact of this ‘technofix,’ worldwide, would pass unnoticed, noting also that China’s energy programme would put, at least, another **1 Gt** y^{-1} of carbon dioxide into the atmosphere in the immediate future.

Some Conclusions.

- (1) Amounts of carbon dioxide emissions into the atmosphere of Planet Earth, must use the dimensions used to describe Planet Earth.
- (2) In the immediate future, is the sequestration of **1 Gt** y^{-1} , increasing by **1 Gt** y^{-1} for each future year (which will only stabilise total emissions) a realistic possibility?
- (3) Demand will be self-regulatory as shortages of fuels raise prices to levels beyond affordability. We are seeing the beginnings of this with the price of crude continuing its climb towards the \$200 per barrel level.
- (4) The evolutionary creation of coal, gas and oil deposits over 300,000,000 years cannot be reversed in a few hundreds of years. Are attempts to replace these deposits with carbon dioxide (sequestration) too optimistic?
- (5) During 2007, of the **30 Gt** of carbon dioxide released into the atmosphere only **12 Gt** are reported to be trapped within the atmosphere (calculated from ppm levels).

Where has it gone? Probably into the oceans! In the short term, is this our saving grace?

(6) The only workable solution is the reduction of emissions by (a) reducing demand (b) by replacement with clean technologies using nuclear fission and fusion reactors and (c) supplemented slightly by alternative energy sources.

Late at night, a wise TV spokesman (a geologist) said that Planet Earth could survive any problem that humans could throw at it. But humans would most likely not survive the process, unless drastic action is taken, immediately.

Harry Marsh: hmarshpaludis@aol.com

Statistics are mainly from the Internet.

(Well what do you think? Of course since Harry wrote this, oil prices have plummeted but will almost certainly rise to former levels and higher in the near future. My view is that work is urgently needed to verify the possibility of CO₂ sequestration and there has been a recent announcement that such a project is going forward in Germany. It does seem though that we missed out in the UK on getting in first by the Government failing to insist on the proposed Kingsnorth power plant having CO₂ removal as a condition of construction permission. The latest news is that this has been mothballed anyway. Ndp)

Nano news

I have shown below a few items that refer to developments, both good and bad, in the use of nanotubes and fullerenes. The first two come from the RSC and some of our RSC members will already have seen them but they are interesting and worth passing on. Chris Ewels sent me the third one, which is basically a manufacturer's puff but it's interesting to see how they have jumped on what looks to them like the latest gee-whiz science bandwagon! The rationale looks distinctly dubious to me but it sounds good to the general public. There was also a picture of an attractive young woman demonstrating the featured tennis racket but I didn't think the cause of carbon science was necessarily greatly enhanced by including it.

Carbon nanotubes behave like asbestos

20 May 2008

Long straight carbon nanotubes may be as dangerous as asbestos fibres, potentially causing cancer in cells lining the lung, a pilot study in mice has shown.

Toxicologists say that those manufacturing and disposing of nanotubes - produced in thousands of tonnes per year worldwide - are most likely to be at risk of an asbestos-like illness, though it's not yet known if workers could be harmed just by inhaling nanotubes at typical exposures. 'We need more research on the toxicology of these materials, and the exposure to them in workplaces,' says Ken Donaldson, who led the research at the University of Edinburgh, UK.

Donaldson's team injected multiwalled carbon nanotubes and asbestos fibres between the membranes lining the lungs and abdominal organs in mice. They found that long straight nanotubes caused inflammation and lesions in membrane cells of the sort that have been shown to lead to cancer - just like asbestos fibres.

The problem, Donaldson explains, is that macrophages, cells which usually swallow up invading objects, can't stretch to engulf fibres that reach beyond about 20 micrometres. Such 'frustrated phagocytosis' leads to inflammation and eventually tumours. 'Anything that's thin, long, and doesn't easily dissolve in body fluids has got to come under suspicion as behaving like asbestos,' Donaldson says.

Nanotubes under twenty micrometres, and long nanotubes which were tangled up into balls, did not cause asbestos-like problems, the researchers found - although the study was not set up to investigate any other potential toxic effects of nanotubes.

'Much more work will be required to provide definitive proof [of whether particular types of nanotubes behave like asbestos fibres], and to show if the same effects are seen if particles are inhaled, and whether exposure levels reach the threshold for the development of cancer,' comments Mike Horton, director of life sciences at the London Centre for Nanotechnology, UK.

But given the terrible effects of asbestos that emerged in the 1960s, researchers are urging caution. 'Those tubes that resemble asbestos should be treated as though they were asbestos and regulated accordingly. In this way, workers involved in their manufacture, use and ultimate disposal will be protected,' says Anthony Seaton, a chest physician who annoyed nanoparticle manufacturers by linking carbon nanotubes and asbestos fibres two years ago.

Tough enough

But nanotube manufacturers are unconvinced that the study means that stricter health and safety precautions are needed.

Del Stark, the CEO of the European nanotechnology trade alliance (Enta), says companies making nanotubes already take the strictest possible safety precautions, so it's hard to see how the research will change manufacturing practice.

Steffi Friedrichs, director of the UK's Nanotechnology Industries Association says that it is not surprising that long insoluble fibres of any material should behave in this way - glass wool has similar effects. Nanotube makers already take measures to minimise exposure, Friedrichs points out.

'We welcome the study - it gives us a very good insight into the potential problems of some types of carbon nanotubes,' she adds. 'But the study needs to be verified, and the researchers have noted important caveats - for example whether nanotubes can actually get to the place in the body that's going to cause damage.'

It's unlikely that those using nanotube products right now (such as lightweight composites in sports equipment) will be in danger of breathing in dangerous doses of free nanotubes, but researchers agreed they would have to demonstrate, rather than assume, low public exposure. 'Even if you took a mallet and hammered a tennis racket, there's probably no danger because the nanotubes are held in a polymer matrix. So if it turns out there's no long fibres for the public to be exposed to - that's great,' says Donaldson

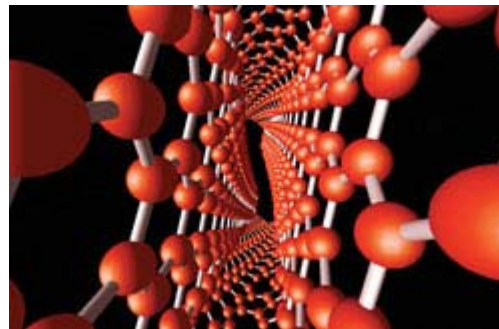
Aside from the need for more health and safety research, the study flags up that not much is known about exactly what types of carbon nanotubes are used in commercial products, says co-author Andrew Maynard, chief science adviser with the US-based Project on Emerging Nanotechnologies. 'There are voluntary agreements for reporting in the UK and the US that not too many companies have signed up to,' he says, warning that the nanotube market might suffer if the public lost trust in the technology because of the stigma of asbestos and because of a lack of transparency. 'It is up to governments to give industry as much guidance as possible,' he adds.

Richard Van Noorden

Manufacturing the carbon nanotube market

Bayer MaterialScience has opened a new carbon nanotube (CNT) production facility at Laufenburg on the German-Swiss border, doubling its production capacity to 60 tonnes per year.

The plant, which began operating in September, is just the latest evidence that chemical companies both large and small are betting on a bright commercial future for the versatile tubes.



Carbon nanotubes: a product in search of applications

'We see a big future in carbon nanotubes and we believe that it's an area of innovation and growth,' said Martin Schmid, head of Bayer MaterialScience's global CNT operations. 'All being well, we will build another plant that will give us a total new capacity of over 200 tonnes of nanotubes by the end of 2009.' Even further in the future, Bayer MaterialScience plans to build an industrial-scale production plant with an annual capacity of 3000 tonnes.

Other chemical companies are also getting in on the act. French chemical giant Arkema, for example, opened a CNT pilot plant in south-west France in January 2006 with an annual production capacity of 10 tonnes. Smaller businesses are also getting involved, whether they are well-established chemical companies such as Thomas Swan in the UK, or new start-ups such as Nanocyl in Belgium, which has a production capacity of 40 tonnes a year.

The attraction of CNTs is that they are lightweight yet strong, and have high thermal and electrical conductivities. Yet despite more than 40 per cent annual growth in the CNT market, its long-term future is still uncertain. 'If the cost and price of carbon nanotubes decrease over the next few years then this will open up new opportunities for the product,' predicted Schmid. 'But if we stay at today's price level then it's probably not going to happen.' And for costs and prices to come down, companies need to find cheaper ways to manufacture CNTs.

Smaller, faster cheaper

Practically every manufacturer currently uses catalytic chemical vapour deposition (CVD) to make their tubes. This involves growing the CNTs by passing a carbon-based gas, such as methane or ethylene, over metal particles that catalyse CNT growth, although each company has developed its own proprietary version of the process.

Improved manufacturing and large-scale production have already caused the price of CVD-produced CNTs to fall substantially, from around \$200 per gram in 1999 to under \$50 per gram today. Although there are other methods for producing CNTs, such as arc discharge and laser ablation, they don't produce CNTs in such large quantities as CVD. So most existing manufacturers are concentrating on developing more efficient versions of CVD, as well as gaining more control over the types of tubes they make.

There are two basic types of CNT: single-walled (SWNTs), which comprise a one-atom thick sheet of graphite rolled into a tube; and multi-walled (MWNTs), consisting of numerous SWNTs nested inside each other like Russian dolls.

Most manufacturers concentrate on producing MWNTs, which are easier to produce with CVD but see wide variations in length, width and number of walls. This doesn't matter for now, because CNTs are usually added in bulk to strengthen polymers in products such as vehicle chassis and sports goods. But more advanced uses of CNTs will require specific types of SWNT. 'An area that is growing very rapidly and is very exciting is advanced electronics,' said Harry Swan, managing director of Thomas Swan, and great-grandson of the company's founder. Indeed, SWNT-based electronic circuits are being touted as one way to continue shrinking the computer chip.

Thomas Swan is already producing SWNTs using CVD, but they cost much more than MWNTs (around \$200 a gram). A number of US companies, including Idaho Space Materials and Nanotailor, have obtained a licence to exploit a novel SWNT production process developed by a researcher at Nasa's Goddard Space Flight Center in Maryland. This uses a helium arc welding process to vapourise an amorphous carbon rod, with carbon nanotubes forming as the vapour is deposited onto a water-cooled carbon cathode.

'Single-walled technology just hasn't taken off because of the cost,' commented Nanotailor president Ramon Perales. 'If we can get the cost down, we can be a step ahead and make higher-quality nanotechnology affordable.'

Chicken and egg

But electronic applications still face a major hurdle: the precise arrangement of carbon bonds in SWNTs determines whether they are metallic or semi-conducting, and all the current synthesis methods produce a mixture of the two.

Although a number of methods have been developed for separating them, such as centrifuging SWNTs in a density gradient or attaching diazonium salts and then separating them by electrophoresis, none have yet left the laboratory.

Surrey NanoSystems, a company spun out from the University of Surrey in late 2006, is helping to address that with its range of CNT generators, which grow tubes at the relatively low temperatures necessary for semiconductor fabrication processes. According to Guan Yow Chen, the company's chief scientist, the devices allow scientists to fine-tune every aspect of CNT production, from catalyst generation to final material processing, and are primarily used as research tools.

If cutting-edge research can open up paths to commercialisation - in applications such as computer chips, sensors and display units - it's likely that a booming market could drive improvements in production to deliver lower costs. To that end, Bayer MaterialScience recently announced that it is looking to set up strategic business and research collaborations to develop novel applications for its CNTs. 'It's going to be a bit of a "chicken and egg" situation,' predicted Swan. 'You'll have to make sure the market place is there before scaling up, but in some instances you have to scale up to make the market.'

Jon Evans

Chemistry World

Yonex® NanoSpeed® RQ Tennis Racquets

Company: [Yonex®](#)

What They Say

Dual Power Structure.

Frame

The new aerodynamically-contoured upper section of the racquet head reduces air resistance, and allows a crisp follow through. It also gives the ideal amount of head flex to store the power and hit the ball with maximum speed.

Shaft

“Matrix C60” for lighter and higher repulsion power. Yonex uses a combination of 0.7-nanometer fullerene carbon fibres and 7-micrometer carbon fibres, taking advantage the fullerene fibres unique ability to form a high-quality molecular bond with the carbon fibres. The Yonex nano-science process concentrates more fibres in the lower third of the head and throat to provide the ideal stiffness for high stability, high repulsion and maximum return of energy to the ball.

The channel at the side of the shaft is a new structure to prevent torque at impact. This channel helps to make a thinner but stiffer frame, so full power is transferred directly to the ball.

(Source: http://www.yonex.com/tennis_tech.cfm)

Happy 10th anniversary NanoteC08!



NanoteC successfully blew out its ten nano-candles in August. Here, my favourite 10 notable facts about the 10th anniversary of NanoteC:

1. The meeting may have been smaller than last year but that didn't make it less interesting. During the 10⁵ seconds of conference we listened to 10 invited speakers and 10*2 contributing talks.
2. At least ten forms of carbon were discussed:
 - 2.1 "just" nanotubes: a lot about synthesis of carpets with CVD by Celia Castro, spinning with Marcelo Motta and arc-discharge with Vojislav Krstic
 - 2.2 Nanobuds: this form of nanotubes with fullerenes (or something similar) stuck on the surfaces was presented by Esko Kauppinen
 - 2.3 Fullerenes are not forgotten by Uchida and Toru, and also they were extra "decorated" with metal atoms by Serena Margadonna
 - 2.4 Bamboos can be very different depending on how much nitrogen they have as Antal Koos told us
 - 2.5 Carbon needles were back by Toru
 - 2.6 And carbon nanotube composites by Dave Carroll
 - 2.7 Nanohorns is my personal new *exotic* form of carbon
 - 2.8 Graphene made by mechanical exfoliation is "out", and according to Coleman the "in" technique is by dispersion
 - 2.9 Diamond and how to make graphite from it was introduced by Steve Bennington
 - 2.10 Buckyshuttle, you don't know what it is? It is a nanobottle with a fullerene inside. We learned more about this new fancy theoretical form in the talk of Suyetin
3. Microscopy resolution is now down to nearly 10⁻¹⁰m using new aberration correctors as Florian Banhart showed us when he kindly stepped in to replace Dave Carroll as the opening speaker. Dave was delayed in New York airport for more than 10 hours!

4. The cyber SEM in Oxford can be used even if you are 10^3 miles from Oxford. Mustafizur Rahman showed us how to use this microscope over the web. Have a go if you have time¹.
5. As part of the session of science communication, for 10 minutes we were all part of one of the games from ES4FUN, but we will be forever in YouTube¹ as example of structural organization. Check out the vacancy migration $10^2+10^1*3+10^0*7$ seconds into the video.
6. As it is always the case in NanoteC, the scientific discussion was carried out around many more than 10 pints of beer.
7. Also, as it is a tradition from this meeting, Malcolm Heggie's speech went 10 minutes too long, contained 10 bad jokes and embarrassed at least 10 people ☺
8. There were 10/5 poster prizes sponsored by the British Carbon Group. The prizes were Ipod nano (less than 10 GB, damn it!) and they went to Antal Koos and Fukuda Takahiro
9. I have only 10^0 complaints, the contributed talks were announced just $10*2$ days in advance, which is in the middle of the summer holidays. Apart from that, I will give a round of applause or a "give me 5" (or "give me 10" and use both hands ☺) to the organising committee
10. Overall, it was a top 10 conference ☺

Let's all raise our Buckyshuttles to the next 10 years of NanoteC!

Irene Suarez-Martinez
 Institut des Matériaux Jean Rouxel (IMN/CNRS),
 Nantes (France)
<http://www.nano2hybrids.net>

ChemOnTubes 2008 Hotel Boston, Zaragoza, Spain 6th – 8th April 2008

I'm told it's quite rare for Master's students to be invited to conferences, so it was with considerable trepidation that I set off to my first international meeting. But on the train from Madrid the staff were smiling and handing out free sweets and headphones, so I relaxed a little; already England seemed a whole world away. This was the second ChemOnTubes conference, the first having been held in France two years earlier. As the name suggests the contributions were all on the chemistry of nanotubes, and over 200 scientists from 28 countries were expected. My overriding concern: what on earth would they make of my poster?

Well I didn't have to worry, because the snow in Oxford had left both my poster and my supervisor stranded. But maybe they'd get here tomorrow?

The first talk was exactly what I would have expected from the sermon at an evangelical church in America; loud, all about friendship, and the man on the stage certainly had a thick Texan accent. It was Ray Baughman, whose huge personality seemed to dominate the lecture room, tea room and lunch room for the next 3 days; culminating in him climbing an electricity pylon after the



¹ <http://www-em.materials.ox.ac.uk/oare.php?instrument=CyberSEM> cyberSEM@materials.ox.ac.uk

conference dinner. There was some science however, and a wide variety of talks and posters with plenty of time for biscuits and discussion kept interest high and the conference hall full throughout. Marc Panhuis talked about loading an inkjet printer with nanotube dispersions, Alberto Bianco discussed injecting radiolabelled nanotubes into a rat and imaging them in real-time, and Jonathan Coleman spoke about his new solvent capable of exfoliating graphite.

Being relatively new to research it was eye-opening for me to see the huge volume and variety of work which is going on in the field of nanotube chemistry. My work concentrates on doping carbon nanotubes with nitrogen, and investigating the changes in their structure and electronic properties. Having spent the last few months quite tightly focused, this was a tremendous opportunity for me to put my work into a wider context, and to appreciate how many pieces of what feels like an enormous puzzle are being worked on at the same time.

My poster never arrived, so I dutifully taped together 12 pieces of A4 and began to capture passers by to discuss my research with. Having previously only considered my work in terms of its potential electronic applications, it was interesting to find the chemists were much more interested in how doped nanotubes could contribute to fields like sensing and catalysis. This has added a whole new dimension to my thesis, and has highlighted how people can look at exactly the same research from totally different angles.

Overall the conference was a tremendous success and hugely enjoyable. I was recently awarded a prize for giving the best thesis presentation in my year, and I have little doubt that the confidence and perspective I gained from attending ChemOnTubes contributed heavily to this. Many congratulations must go to Wolfgang Maser and Cécile Zakri, the conference chairs as the whole event went off without a hitch, and I would like to particularly thank the British Carbon Group for supporting me in attending.

Mike Dowling



The Annual World Conference on Carbon, Carbon'09 will take place in Biarritz
Write the dates on your Agenda : June 14th – 19th 2009 ...!

[CONFERENCE REGISTRATION is now OPEN.](#)

[Don't wait to register!](#)

SUBMIT YOUR SHORT ABSTRACT: Plan to submit your best!

You might be selected for a keynote.

November 15th 2008: Deadline for Short Abstract submission (be careful, short window!)

Please now click on the related links above: www.carbon2009.org

We are waiting for you,

Best regards,

The Organisation Committee

Isabelle Sail

TERRES BASQUES - CARBON 2009

4 avenue de paillet

64200 BIARRITZ - FRANCE

carbon2009@terresbasques.com

Direct line: 00 33 (0)5 59 41 74 46

Tel : 00 33 (0)5 59 41 14 21

Fax : 00 33 (0)5 59 41 14 74

Adsorbed Natural Gas (ANG)

ANG is a topic that I thought was dead but it apparently won't lie down. There was considerable interest both industrial and academic some 15-20 years ago because it offered a way of storing natural gas in a condensed form. Highly activated carbon was the material of choice and the group I was working with, as well as one or two others, achieved the target of storage 150 volumes of gas per volume of carbon at 34 bar (500 psia) at ambient temperatures. Compare this with figures of 250 for compressed natural gas (CNG) at 200 bar and 600 for liquefied natural gas (LNG). On the other hand, the cost of compression using a simple single-stage compressor was much less than for CNG. Unfortunately, the cost of making the special carbons was such as to preclude it from displacing either CNG or LNG for transport use. Or so I thought.....

Recently, I received the newsletter from Advantica Technology who have inherited the IP of the former British Gas plc and as you can see from the announcement below, they are still active in the field. The photo shows the proud award winner in the middle and to her left, Dr. Rob Judd, a former colleague of mine, who oversaw her project. What did Miss Lau do to gain this award, I hear you ask? Well, she developed a storage system based on using carbon adsorbent to store natural gas for use on, wait for it, a motor cycle! Those of you who know me will appreciate the irony.

More seriously, I see from the internet that there is still a great deal of activity in applying ANG in the Far East, especially in the Indian sub-continent. This was very likely the motivation of the sponsor for the Advantica contract. Natural gas does have great advantages as a transport fuel, being relatively non-polluting and efficient. There are increasing amounts of it about and in India they are making serious efforts to produce small vehicles and especially motorcycles running on it. The problem has always been that of storage but ANG seems to be a cheap way of achieving this. I shall watch future developments with interest.

“Advantica has been recognised as the winner of the prestigious Young Persons’ Achievement Award offered by the Institution of Gas Engineers and Managers (IGEM) and the Society of British Gas Industries (SBGI).



During the recent award luncheon held at London's Park Lane Hilton Hotel, IGEM and SBGI bestowed Advantica's Lay Yen Lau with the Young Persons' Achievement Award for her work in bringing forward the development

and implementation of **Adsorbed Natural Gas (ANG)** technology on two separate fronts, in both cases with support from the BG Group and their Indian Assets; the development of the first 2-wheeled motor vehicle based on ANG storage and the planning

and design of the first network scale demonstration of ANG technology. ANG is a technology which allows the storage of natural gas in substantially larger quantities than compressed gas at an equivalent pressure.

Lay Yen's contribution stretched from initial project conception through to completion for both applications. For the 2-wheeler development, her production of a sophisticated financial and techno-economic model showing the potential benefits of the conversion to gas company and end user led to acceptance of the business case and proposal for funding. Working alongside clients, Lay Yen developed the design basis for the ANG tank, fuel system, and potential fuelling station modifications. Furthermore, she then took the project through to a field trial of a converted vehicle. In parallel, Lay Yen worked closely to plan the implementation of an ANG network storage solution from feasibility through to design."

And finally.....

(I received this via e-mail, quite unsolicited, some time ago. I assume that it's not a hoax but it's a rather an odd document to say the least. I didn't reply)

Dear Sir,

We are in the market for charcoal to supply the Restaurant market in Israel.

- Volumes required per month in tonnage - 60 - 75 Ton per month max 100 Ton per month
- The volumes required per month is on regular volumes
- Package requirements -container sizes, 40 Fit container
- Bag requirements - colored bags or plain, three or two ply bags to be used - Please advice?
- Bag size eg. 2kg, 5kg, 10kg or 25kg

Technical specifications as follows:

Moisture: 6% max
Ash Content: 3.5%max (on dry basis)
Carbon Fix: 75%min (on dry basis)
Volatile matter: 12 % max
Particle size: 50 mm up to 90 mm
No sparking

The best wood charcoal is from Citrus Tree like Orange lemon... trees

Delivery and payment method used - We prefer to work FOB on confirmation received by Letter of Credit (LC). – Please explain your position – manufacture or broker – and how can you guarantee the quality?
We also prefer to work on a fixed term contract basis.

Please quote, per ton or per container FOB & CIF Haifa or Ashdod port at Israel

Trusting we will be able to do business one all the finer details have been confirmed and resolved.

A waiting your reply.

Kind Regards,

(For amusement only)

Letters to the Gas Board

As I have said elsewhere, I spent my life working in the British gas Industry. The following appeared anonymously on a notice board in our laboratory several years ago. The reference to the "Gas Board" and the North Sea suggests that it dates from at least 30 years back. No claims are made as to its genuineness but the items are printed as received.

Your fitter wanted us to try it in the fireplace but we think it is better in the cupboard.

Can you move the meter so it won't cause an obstruction in my passage.

The electrician did it through the floorboards but your man put it in my front passage where everyone can see it.

I don't like it so much in the kitchen as I did in the showroom window.

Since you put a new pipe from the mains into our house, my husband and I dread going to bed because of a slight discharge. We think there is a leak just before it enters.

I have heard there are two ways you can have it and it works out cheaper the more you get if you have it the other way.

I am not satisfied with an apprentice so will you send a man to do it properly. *(an old chestnut)*

My wife will be ready for your man if you let her know when he is coming on a postcard.

I will try to pay before the end of the month as my husband will be mad if you cut it off without telling him.

My husband is pretty handy but he says your men can do it better because of their tools.

It has got slack with use and my husband can't make it tight no matter how he tries, so for the time being, we are making do with an old rag.

My slot isn't blocked now but your men made an awful noise banging their tools on the wall.

Since I made the arrangement with your salesman, I am having a baby and would like to change it for a drying cabinet.

My neighbour has a bigger one than me and it makes a difference to her water when she is filling the bath.

My husband was under the impression that I was getting it at reduced rates but your salesman didn't use his head and got me into trouble.

It is about time your workmen came back to fill the hole because we are fed up with having it in the street: it is a big attraction and we get children by the dozen.

A woman who is after the house says she is not keen on it so if she gets it, can your men stand by to take it out before she comes.

I have six children, if you do not do something about the leak the coroner will blame you.

I told my husband that it was safe to leave it in all night but he won't. If he comes to the showroom like I did, can the lady satisfy him behind the counter and talk him into it. *(Too good to be true this one!)*

I was told mine was no good but if it is altered I can get the North Sea in.

--