



The new POLARIS vacuum tank being installed at the ISIS Neutron and Muon Source, Rutherford Appleton Laboratory, Oxfordshire. Polaris is a high intensity, medium resolution powder diffractometer. It is optimised for the rapid characterisation of structures, the study of small amounts of materials, the rapid collection of data sets and the study of materials under non-ambient conditions.

Photograph courtesy of STFC.

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Chair's Report 2013

It was a surprise to me to discover that the Vacuum Group Committee will have its 200th meeting this September. This was also slightly worrying at a personal level as it means 48 years have passed since I joined what was then the Vacuum Physics Group in 1965. The journal *Vacuum* will also publish its 100th volume this year, having started life as an in-house journal of Edwards High Vacuum in 1950. All this made me realise how important the subject of vacuum is and how this status has survived over the last 63 years; current evidence shows that it will continue to survive. Our symposium at the 2012 VacuumEXPO demonstrated this from the topics of the talks which described the many areas where knowledge and application of vacuum are vital for a wide range of industrial processes. In addition, although many IOP groups concentrate on specific properties of surfaces and materials, they still require vacuum processing to generate their test materials.

With these 100 and 200 landmarks one may ask "why did the interest begin to develop so rapidly in the mid-20th century?" The main driving force was at first related to the war effort where improved vacuum valves and industrial mass-spectrometers were essential, the latter for separation and collection of uranium isotopes. In the 1950's new semiconductor devices appeared which required good vacuum conditions for production. Soon after this ion-implanters were required for controlled doping of a wide range of improved semiconductor components. Hence there was a surge in interest in pumping, measurement of pressure and residual gas analysis. Glass vacuum systems were replaced by all-metal systems; microns and millitorr were superseded by Pascals and millibar. This is why we started as an IOP Group in 1965 as, at that time, there were many new developments in the field.

The Group continues its endeavours to appeal to as many people as possible in industry and research by arranging meetings covering the widest range of subjects where pressures below an atmosphere are an important element. The composition of the Group Committee reflects the broad coverage of the subject aimed at by the Group, encompassing academics, representatives of vacuum manufacturers and vacuum users in government and industrial laboratories. The Group has been successful in bringing together those engaged in the production and improvement of vacuum equipment with those concerned with its application in such diverse areas as medical physics, large machines for research in the physical sciences, industrial process control and the electronics and semiconductor industries.

The Vacuum Group takes an active interest in education for those working with vacuum technology. An outline of training courses offered at the 4th Vacuum Symposium in Coventry on 16-17 October 2013 is given in this newsletter. The Group continues to maintain close links with the British Vacuum Council (BVC) with a member of the Group committee serving as one of the Institute of Physics representatives on the Council. Through the BVC, which represents national vacuum interests, members are able to participate in the work of the International Union for Vacuum Science, Technique and Applications (IUVSTA) which, this year, runs its International Vacuum Congress in Paris from 9 – 13 September.

During the past few years, the Group has organised a wide programme of half-day and full-day meetings, some of which have taken the form of workshops or included mini-exhibitions. The subjects of meetings have included information on choosing and using vacuum equipment, environmentally friendly cleaning of vacuum components, energy-assisted coating, motion in vacuum, automation and control, diamond growth, pressure measurement, ion sources, plasma sampling and surface analytical techniques.

The Group is now running one of its meetings at the annual Vacuum Symposium with the fourth of these scheduled to take place at the Ricoh Arena, Coventry from 16-17 October as part of Vacuum Expo 2013. This year's Vacuum Group meetings will include Vacuum-based Coating Techniques and Applications (16 October) and All Aspects of Leak Detecting (17 October). In addition there will be an equipment exhibition, vacuum training courses and a poster prize award. Information on <http://www.vacuum-uk.org>

We co-sponsor two other annual meetings run by the Ion and Plasma Surface Interactions group: Plasmas, Surfaces and Thin Films, run in June and Thin Film Photovoltaics, in September.

I would like to take this opportunity of inviting members of the Group to suggest hot topics for future events. Please also send me news items on events and new reports on topics of interest to our vacuum community.

My thanks to all members of the Group Committee for their hard work during the year and for regularly attending committee meetings. Thanks are due also to IOP staff for their valuable support of our activities and to all group members for their ideas and input to meetings.

John Colligon (J.Colligon@mmu.ac.uk).

Notice of Annual General Meeting 2013

The 2013 AGM of the Vacuum Group will take place on 16th October 2013 at 1200 hrs following the last lecture of the morning session of VS4 at the Ricoh Arena, Phoenix Way, Coventry CV6 6GE. All members and observers are welcome. We are always looking for new members to serve on the Committee.

Please contact Carl Richardson for details if you would like to stand for election (carl@crc-technology.com).



4th Vacuum Symposium UK

Vacuum Symposium UK was formed to embrace all of the UK vacuum community. Its aim is to bring together academics, industrialists, engineers, manufacturers and anyone using vacuum to promote UK pre-eminence in the subject.

Vacuum is a key enabling technology for a wide variety of applications that are of growing importance in the 21st Century. Whilst there is an abundance of information on the Internet we believe that the annual event organised by Vacuum Symposium UK provides a unique opportunity for networking and education, in addition to topical meetings of interest to vacuum users.

The meetings within Vacuum Symposium UK are free to attend. VS-UK welcomes anyone with experience and contacts to organise a vacuum-related meeting that will attract and interest the diverse spectrum of vacuum users. See the website www.vacuum-uk.org for more details.

The Vacuum Symposium event is co-located with Vacuum Expo – the UK's premier exhibition of vacuum equipment – all on one site, under one roof. Attendees are welcome to attend on one or both days of the event – this year it will be held at the Ricoh Arena, Coventry on 16th and 17th October.

Vacuum Symposium UK is an independent organisation (Registered Charity No. 1137989). Its roots are based in the RGA User Group but nowadays VS-UK seeks to encompass all aspects of vacuum with a view to establishing a UK annual event worthy of hosting an International vacuum conference.

Steve Shannon
SS Scientific Limited

Vacuum-based Coating Techniques and Applications **One day meeting at VS4 on 16th October 2013, Ricoh Arena, Coventry**

Provisional PROGRAMME

- 0900 Welcome and Introduction: John Colligon
- 0910 Effects of energy-assistance on coating microstructure
John Colligon, Manchester Metropolitan University
- 0940 Atomic Layer Deposition
Erwin Kessels, Eindhoven University of Technology
- 1010 Magnetron Sputtering for versatility and Quality Coatings
Peter Kelly, Manchester Metropolitan University
- 1100 Introduction to High Power Impulse Magnetron Sputtering
Arutiun Ehasarian and Papken Hovsepian, Sheffield Hallam University
- 1130 Extreme Amorphous Carbon Materials Applied Using Plasma-Assisted CVD
Chris Walker, Diamond Hard Surfaces Ltd., Towcester
- 1200 Lunch break and Exhibition.
- The Annual General Meeting of the IOP Vacuum Group will take place immediately after the morning session***
- 1400 Molecular Beam Epitaxy
Mohamed Henini, University of Nottingham
- 1430 Surface Treatments and Surface Coatings for Modern Particle Accelerators
Oleg Malyshev, STFC Daresbury Laboratory
- 1500 15 minute Contributed papers. Please send titles to j.colligon@mmu.ac.uk
- 1630 End of meeting.

NB: The Poster Prize presentation will be in the Exhibition Hall at 1700hrs on Thursday 17th October

Vacuum Technology Training Courses at VS4 16th and 17th October, Ricoh Arena, Coventry

VTC1 Vacuum: the basic principles,

VTC2: Vacuum in practice

VTC3: Clean vacuum and UHV

The purpose of these courses is to present basic vacuum knowledge in a straightforward and accessible way. The principles and practice that are involved in creating and measuring a vacuum will be dealt with and illustrated by worked examples from various applications. Ultra-high vacuum, important in many applications, will be discussed only briefly in courses VTC1 and VTC2, however they will serve as a good introduction to the course “Clean Vacuum & UHV” (VTC3) which addresses the matter of UHV in more detail.

These courses are aimed at newcomers to the field, those who wish to refresh their knowledge, and those who wish to go further into UHV practicalities. They will be appropriate for new graduate students in physics, chemistry and engineering for whom vacuum techniques will be a working tool. More information is available at www.vacuum-uk.org/training_vs4.htm

VTC1: Vacuum - the basic principles

This will deal with the principles involved in creating and maintaining a vacuum. The various aspects of gas behaviour that are important for this purpose will be described, together with the characteristics of flowing gas and how they change as pressure falls. On the basis of this analysis, flow can be specified quantitatively and performance predicted.

VTC2: Vacuum in practice

The subject of this course is how vacuum is produced and measured in a few typical devices whose operation reflects the application of the principles described in the VTC1 course. A representative selection of simple systems will be described and analysed.

VTC3: Clean vacuum and UHV

This course is primarily aimed at those who need to use equipment operating at vacuum levels of 10^{-9} mbar or lower and is approached mainly from the physics aspects of vacuum science. Therefore, the course will emphasise the physical principles of equipment and processes. There will be little mathematics or advanced physics used, so it will be suitable for people with an engineering or technical background.

Joe Herbert - ASTeC STFC Daresbury Laboratory

Meeting Report: Vacuum and Plasmas for Industry - Essential Ingredients for Manufacturing Success

17th October 2012, The Ricoh Arena, Coventry, UK

This meeting was organised by the Vacuum Group in collaboration with the Ion and Plasma Surface Interactions Group as part of the 3rd Vacuum Symposium. The theme of the meeting was to highlight areas where vacuum and the use of plasmas are important (and often essential) ingredients in industrial processes.

Plasmas provide a unique environment for industrial processes, provided that they are excited with gases admitted into a quality vacuum. Attention to cleanliness and contamination plays an important part in achieving the optimum vacuum and plasma conditions. The common theme of vacuum and plasmas was emphasised in the presentations to demonstrate their importance to manufacturing success.

The meeting comprised nine oral presentations. Sixteen poster papers were presented in the Exhibition Arena. Each of the morning and afternoon sessions opened with talks from the well-known companies, Intel and Seagate. Niall Macgearailt from Intel, Ireland, started the meeting with “Plasma Process Control in the Semiconductor Industry”, which described the challenges of volume production world-wide and keeping control of the plasma processes to keep the yield high and the production line moving.

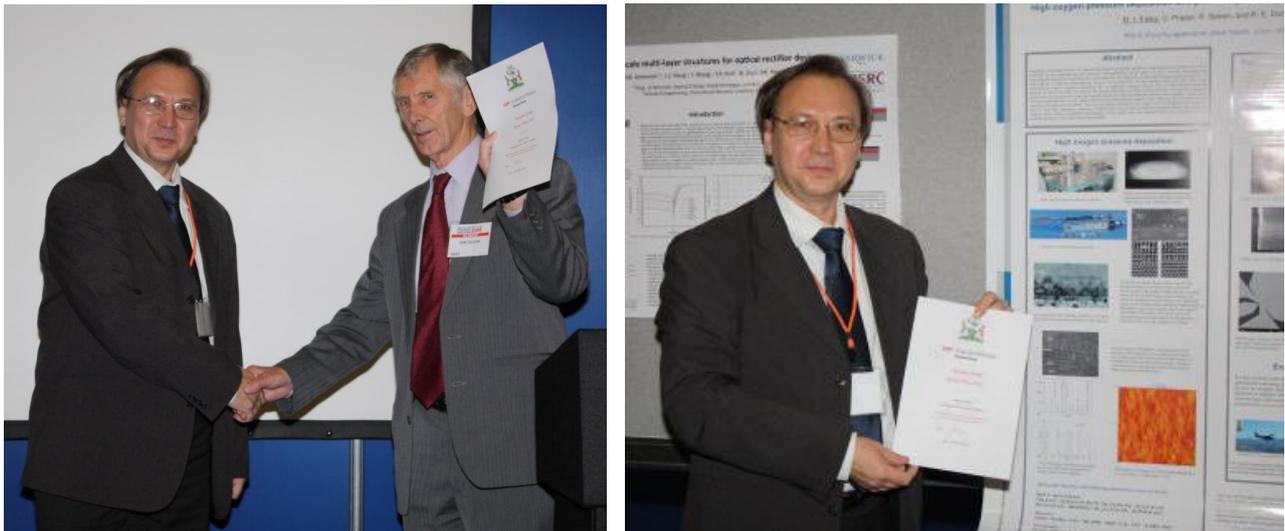
The Annual General Meeting of the Vacuum Group was held just before the lunch break which was scheduled to provide enough time to visit the exhibition and posters.

Denis O’Donnell from Seagate opened the afternoon session with “Plasma-based Processes for Volume Manufacture of Magnetic Recording Heads”. Other highlights included a comprehensive description of the importance of vacuum and the control of pressure in freeze-drying by Kevin Ward of Biopharma Technology Ltd. and the use of plasmas was emphasised in the treatment of textiles by Delwyn Evans from P2i Ltd.

The meeting drew sizable audiences, in keeping with the quality of the presentations. It is rare that so many speakers from industry were assembled within one programme and we, the organisers, are grateful to all speakers and their companies and organisations for their contributions which made the day so successful. The meeting was co-ordinated by “Vacuum Symposium UK” <http://www.vacuum-uk.org>

Alan Webb and John Colligon

Vacuum Group Poster Prize Winner at VS3



Dr Michael Faley receiving the 2013 Poster Prize certificate from John Colligon

An annual poster prize worth £100 is awarded by the Vacuum Group. Recently the competition has been open to all delegates registered for the vacuum and coating-related seminars held during Vacuum EXPO. The entries for this competition were at a very high standard but the judges agreed that the poster by Dr habil Michael I Faley et al, who is shown receiving the prize in the photographs above, was a clear winner. A short overview of the work described in the winning poster has been provided by the winner.

High oxygen pressure deposition and patterning methods for metal oxide heterostructures

*M. I. Faley, U. Poppe, R. Speen, and R. E. Dunin-Borkowski
PGI-5, Forschungszentrum Jülich GmbH, Jülich, 52425, Germany*

Significant technological efforts are required to produce high-quality samples of superconducting cuprates due to their sensitivity to the compositional and structural inhomogeneities. Since about 24 years we develop the technology of high pressure sputtering for oxide materials [1-4]. The technique of sputtering at high oxygen pressures (1 - 4 mbar) allows a smart and homogeneous on-axis in-situ deposition of high-quality metal-oxide thin films from stoichiometric targets avoiding resputtering due to negatively charged oxygen ions. If conventional sputtering pressures of about 0.01 mbar are used for the on-axis deposition of cuprate superconductors, the negatively charged oxygen ions are accelerated towards the heated substrate by the bias potential and they thus resputter copper atoms from the deposited film leaving copper-deficient non-stoichiometric cuprate films. With the high

oxygen pressure sputtering technique, this problem is solved by multiple scattering of the oxygen ions at background gas pressures above 1 mbar with subsequent reduction of their kinetic energy down to thermal energies before they reach the substrate. This results in negligible backsputtering of the copper from the deposited films and, consequently, their good surface morphology, stoichiometry and electron transport properties.

For patterning of the metal oxide heterostructures we have used: (1) deep-UV photoresists PMMA and AZ TX1311; (2) non-aqueous chemical etching in Br-Ethanol, by ion beam etching, or by FIB; (3) cleaning and heat treatment in oxygen plasma of the oxide heterostructures before deposition of top layers. The 300 nm high steps on MgO substrates for high- T_c step-edge Josephson junctions [5] were prepared using a two-part milling process with Ar ion beam etching. Epitaxial growth and patterning of the films were controlled by HRSEM, AFM and HRTEM [6].

The use of the high oxygen pressure deposition technique has allowed to produce high quality metal oxide films of high- T_c superconductors, dielectrics, ferroelectrics, magnetic oxides, CMR-materials, etc. Typical superconducting transition temperature of the $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ films obtained by this method is about 93 K and their critical current density is about 6 MA/cm^2 at 77.4 K. The oxide heterostructures prepared by using the above mentioned methods were mainly intended for production of sensitive high- T_c superconducting quantum interference devices (SQUIDs), which are integrated in more than 100 magnetic field measurement systems for geomagnetic and biomagnetic applications worldwide.

1. U. Poppe et al., Patent US4965248, (1990).
2. U. Poppe et al., J. Appl. Phys., vol. 71, 5572, (1992).
3. M. I. Faley, In "Applications of High- T_c Superconductivity", ISBN 978-953-307-308-8, 147 (2011).
4. M. I. Faley and U. Poppe, Patent WO2012051980, (2010).
5. M. I. Faley, Patent pending DE102012006825, (2012).
6. M. I. Faley et al., IEEE Transactions on Applied Superconductivity, v.23 Issue 3 part 1 p.1600705 (2013).

BVC The British Vacuum Council

The British Vacuum Council

The web site, after it had a grand restructuring last year, is being regularly updated with events, news, conferences and meetings that the Council sponsor, support and endorse. This is all thanks to Dens Milne and her team at IOPP.

One such major event this year is The International Vacuum Congress in Paris, 9-13th September 2013. The details can be found on the web at <http://www.ivc19.com/>

Besides the BVC news, the web site is also the link to IUVSTA. The eight IUVSTA Divisional Representatives are co-opted onto the BVC Committee. The end of the triennium is upon us and these are about to change or be re-elected. See all the International Union news at : <http://iuvsta-us.org/iuvsta2/index.php>

The Council has two prizes, which are normally awarded annually. The Senior Prize, which is associated with The John Yarwood Memorial Medal, had an unprecedented six nominations for last year's prize. The choice, made even more difficult due the standard and quality of the nominees, was eventually reduced to three candidates and the winner was Professor Richard Palmer from The University of Birmingham.

The Junior Prize had three nominees. The term Junior is defined by the candidate having to be within ten years of receiving their first degree. The prize comprises the C R Burch Prize and BVC Medal, and was awarded this year to Dr Philip King from St. Andrews University.

Nomination forms for this year's prizes can be found on the web site :

<http://physicsworld.com/cws/company/C000018818/home>
<http://www.british-vacuum-council.org.uk/>

Alan Webb
The Open University

Update - Waters Corporation - New Mass Spectrometry Headquarters near Manchester, U.K.



Last year we reported on the building of a new mass spectrometry headquarters in Wilmslow near Manchester, UK by Waters Corporation. The following is short update on the progress.

Waters Corporation, an American-owned corporation, with a key business strategic venture in Manchester, is developing its Mass Spectrometry Headquarters in the North West of England with the building of a world-class facility with combined advanced R&D, manufacturing capabilities and customer demonstration laboratories.

The construction of the £60m headquarters began, on the 37-acre Stamford Lodge site on the A538 Wilmslow/Altrincham road, three miles south of Manchester Airport, at the beginning of 2012. The construction of the headquarters itself is on schedule and will be completed in late 2013, more than 500 employees, currently located on four separate sites in South Manchester and Altrincham, will be relocated to the site over the following 12 months. Interestingly, and as I mentioned in last year's comment, the new facility will be built to BREEAM standards (Building Research Establishment Environmental Assessment Methods), which are the accepted measure used to describe a building's environmental performance, and encourage best

practices in sustainable design. This aspect was a central criterion of the development and is very much supported by the workforce.

Also, reported last year was the fact the original building plans had to be modified to include the relocation of a colony of Brandt's bats roosting in Stamford Lodge, a derelict building on the site. In fact 4 species of bat were found to roost in the Lodge: Brandt's, Soprano, Pipistrelle and Brown long-eared bats.

To satisfy the current planning regulations a special building was included in the site development plans to house these protected species. The new bat house was completed in early May 2012 and in the early summer of 2012 the bats began to migrate to their new purpose built bat house. The house had been created specifically to imitate the conditions of Stamford Lodge and had been positioned along the foraging flight path of the bats.

During the spring and autumn period of 2012 ecologists regularly monitored bat activity, carrying out dawn and dusk surveys and in October 2012 the ecologists re-housed the last stragglers, waifs and strays. The timing of the different stages of the re-housing plan was closely adhered so that the breeding and hibernation patterns of the bats were not disrupted. Not long after re-housing, the old Stamford Lodge was demolished, the bats are now living happily ever after and the workforce is looking forward to the move.....a success I think.

Gordon Jones
Waters Corporation

Forthcoming Events

International Union for Vacuum Science, Technique and Applications (IUVSTA) runs its International Vacuum Congress in Paris from 9 – 13 September 2013.

The Group plans to run a meeting on “Surface Modification and Analysis” in 2014. We will also co-sponsor the IPSI annual meetings on Plasmas, Surfaces and Thin Films and Thin Film Photovoltaics. We plan to join Vacuum Expo again in October 2014 to run our meeting at the 5th Vacuum Symposium. Check the Vacuum Group web-site at www.iop.org for further details.

IUVSTA will hold its 16th International Conference on Thin Films in Dubrovnik, Croatia from 13–16 October 2014.

Committee 2012-2013

Chair: Professor John Colligon
Hon Treasurer: Mr Joe Herbert
Hon Secretary: Dr Carl Richardson

Members: Dr Matthew Cox, Dr Gordon Jones, Dr Sunil Patel, Dr Steve Shannon, Dr Steve Taylor, Dr Alan Webb, Mr Andrew Chew, Dr Oleg Malyshev, Dr Oliver Williams

This newsletter is also available on the web and in larger print sizes

The contents of this newsletter do not necessarily represent the views or policies of the Institute of Physics, except where explicitly stated.

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