
Electrostatics Group Newsletter

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Institute of Physics

Letter from the Chairman

Electrostatics is a curious science: in fact there are probably few amongst us who haven't occasionally been forced to wonder whether it is an art rather than a science, and, when caprice appears to rule the day, maybe a black art at that!

For all that, the study of electric charge and electric fields is amongst the most venerable of the branches of physics, and it is salutary to remember just how many of the fundamental phenomena of electrostatics have been known for a very long time. It seems to me, however, that despite its long and illustrious history, the subject goes through phases of popularity and perceived importance as the demands of technology or the needs of the moment dictate.

When this group was founded a poll of its members would most probably have shown majority interests in such areas as xerography and printing technologies, surface finishing, crop-spraying, meteorology, dust control and incendiary hazards, with concerns to measure, exploit or control electric charge in these situations. These topics are, of course, of enormous scientific and economic importance today, but emerging technologies have brought equally enormous challenges that draw heavily on the science of electrostatics.

'Nano-' must be the most heavily used prefix at the present time – one cannot open a newspaper or magazine, or watch a TV programme without running a serious risk of encountering these four letters, and nanotechnology in its broadest terms offers wide scope for developments undreamed of only a few years back. Down at this scale it is very quickly apparent that electrical forces become dominant, with small physical distances and electrical capacities giving rise to often extremely large potentials and consequent fields. Working in this area soon convinces one that scaling laws can have their limitations, and new approaches to understanding the physics of the very small are fast developing, drawing heavily on both theoretical and applied electrostatics in the process.

The world of MEMS, although now well-established, continues to expand rapidly, and in turn proves fruitful ground for the electrostatics expert. There is still a general lack of electrostatics expertise and I believe the current scope for the subject to be large and of great significance.

All of this leads me on to you – the members of the Electrostatics Group of the Institute of Physics. We are long and well established, and few of you can have failed to notice how the quadrennial Conference that forms a central part of our programme attracts a significant percentage of the world's leading experts in the field. Our most recent and successful Edinburgh Conference is reviewed elsewhere in this Newsletter, suffice it to say here that once again it brought together almost all imaginable electrostatic interests from all round the world, and I suspect that few present left without gaining significant insights into contemporary research and development in the field. That said, we need to be vigilant. We are not a big group – some hundred members worldwide – and we need to grow to remain viable.

The Electrostatics Group exists for one primary purpose only, that of serving the needs and interests of its members. This, of course, is where *you* come in. It is only by making those needs known that we can address them, and I can assure you that we are very keen to do just that. Occasional topic-specific Meetings and one-day Conferences can be stimulating and productive, as can more social occasions that give the opportunity for less formal discussion. Tell us what you would like, and we will do our best to arrange it – if you would like to help in this task then your assistance would be most welcome. There is no hard-and-fast rule that says that such meetings have to be in London. Whilst this is often a convenient venue for many, we are well aware of life outside the M25!

We could also do well to increase our numbers. If you have colleagues interested in the field, then persuade them to join us! If they are already Members of the IoP, they are entitled to join Groups at the very modest rate of £5 p.a., and if they are working in the field and *not* Members of the IoP then lean heavily on them to join this exciting and important Institute!

If you are an academic and have students then make sure that you point out the extremely good value of IoP Student Membership. Furthermore, Student Members may join one Group (ours, of course!) free of charge. Students are always most welcome at any of our events, and One-Day Meetings of various sorts are an ideal platform at which to present first papers.

Mention of students brings me to my final theme – Education. Those of us who have also been involved in school education feel that there is a considerable need to review the teaching of electrostatics. Much has been done in the earlier years, and it is to the credit of the National Curriculum that children are introduced to the subject in the early Key Stages. However, once the excitement of the charged balloons, the polystyrene beads in a dry soft-drink bottle, or maybe a first encounter with a Van der Graaf machine have died down, the remainder of the curriculum at both GCSE and A levels is both thin and somewhat uninspiring. I believe that we have a quite urgent need to introduce youngsters to the world of electric charge and forces much better than we currently do. If you are involved in education, or know of colleagues who are, then we should love to hear from you. If you need help, then maybe we can assist – there is some body of educational expertise at your disposal. If you have ideas that you wish to share, or that you would like to see developed, then we should also be delighted to hear from you. Remember – we shall need more, not fewer, electrostatics experts in the future!

May I finish by wishing you all a very happy and successful New Year.

Jeremy Ahern.

Chair, Electrostatics Group.

Report on the Electrostatics 2003 conference

The 10th Electrostatics conference was held as part of the IoP congress in Edinburgh from the 23rd to 27th of March 2003. It was attended by over 120 delegates from many different countries. Over 80 papers were submitted to the conference and 60 papers were accepted for publication in the IoP conference series proceedings.

The conference was preceded by the traditional Introductory Workshop in Electrostatics, which is aimed at understanding, assessing and tackling electrostatic problems and opportunities. This year the workshop was presented by Paul Holdstock, Tom Jones and John Chubb. Tom showed a fascinating range of demonstrations that were well received by the attendees, including triboelectrification, the electrophorus, a dissectible capacitor, and Faraday shielding. Many of these can be seen on his web site at <http://www.ece.rochester.edu/~jones/demos/>.

The conference traditionally opens with the Bill Bright Memorial Lecture. This year, we had the honour of hearing Tom Jones, from the University of Rochester, talk on Electrostatics and the Lab on a Chip. This lecture was also the plenary scientific talk of the Institute's Congress. Prof. Jones captivated his audience, highlighting advances made in the applications of electrostatics in microsystems, particularly for the manipulation of fluids and particles.

Several eminent speakers provided us with up to date reviews on their research. Ulrich von Piddol, of Physik Technische Bundesanstalt, Germany, gave a lecture on electrostatic ignition hazards by. He described the general issues associated with electrostatic detection and hazard prevention. In the first half of his talk, he showed some recent industrial fires probably caused by electrostatic discharges, including car fires during refuelling, sparking caused by hair spray bottles and fires on printing machines. In the second half of his talk he showed how we can evaluate ignition hazards in terms of charge transferred during an electrostatic discharge.

Carol Livermore from MIT described how MEMS technology could be used to manufacture microscale induction machines for lightweight and compact power sources, including tiny gas turbine engines and electric

micromotors and generators. The design, fabrication and testing of a mm scale electrostatic induction motor/generator was described in detail.

Masao Washizu from Japan gave an illustrate talk showing how electrostatics can be applied on the micro-metre scale to manipulate and even dissect single molecules of DNA.

Antonio Castellanos provided a detailed insight into the effects of electric fields on fluid in micro-devices, where the scales are different and it is relatively easy to generate extremely high electric fields with only a few volts.

Jaakko Passi from VTT Industrial Systems, Finland then presented an overview of ESD issues some results from the ESTAT garments project, which is researching, test methods and ESD from protective materials and garments routinely used in the electronics manufacturing and fabrication industry.

The conference finished with a lecture by Peter Castle from the University of Western Ontario on electrostatics and the environment. He discussed in detail the various mechanisms that give rise to lightning strikes, and how the damage can be virtually eliminated through the use of suitable lighting conductors. He showed how electrostatic precipitators could be used to remove contaminants from the air and highlighted some of the challenges facing technologists in extended these processes to more complex pollutants. He went on to discuss how electrostatics could be potentially applied on an industrial scale to separate different types of plastics for recycling.

A timely reminder of the political scene during the conference was the publicity generated by the paper from Ed Law on the application of electrostatics for decontaminating the human body from chemical and biological warfare agents. He showed how the penetration rate for decontaminants could be markedly increased when electrostatic charging of the spray droplets was used in a portable walk-through electrostatic decontamination shower.

The conference dinner was the highlight of the week, when we were entertained with a veritable feast of Scottish music and dance, and the wine and whisky flowed freely.

Current committee (as of 26th March 2003)

Jeremy Ahern (chair), Brunel University, UK
Nicolas Green (secretary), University of Glasgow, UK
Jeff Allen, Scion Sprays, Norfolk, UK
Lindsey Gaunt, University of Southampton, UK
Giles Harrison, University of Reading, UK
Paul Holdstock, British Textile Technology Group,
Lancashire, UK
Peng Miao, Imperial College London, UK
Hywel Morgan, University of Southampton
Jeremy Smallwood, Static Solutions, Southampton, UK
Martin Taylor, University of Wales, Bangor, UK

Message from the editor

If you have any matters or articles that you would like to appear in the newsletter or, indeed, any comments or questions about the Electrostatics Group, please contact me by Email or at the address below.

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Message from the Committee

This is the first newsletter from the Electrostatics Group. In fact, it is only recently that the name of the group changed from Static Electrification. We have several events planned for the forthcoming year and would welcome any suggestions

from members for more. Details of these and the dates of future meetings and the AGM will be included in the January newsletter and will be posted on the redesigned web site that we hope to have in place soon.