

BMSS Educational Activities

Chris Laphorn, BMSS Education Officer.

This edition of Mass Matters focuses on Education and includes an overview of how the British Mass Spectrometry Society invests and encourages education, and some commentary and highlights of education and outreach in the UK. We are very grateful in particular to Prof. John Langley (University of Southampton), Dr. Stephen Holman (University of Liverpool) and Giles Edwards (University of Manchester) for their contributions to this edition of Mass Matters.

To give education in mass spectrometry some context it is worth considering where it all started...the British Mass Spectrometry Society was founded in 1964 and the first meeting of the Mass Spectrometry Group was held in London in 1965; the society continued to serve as a new community for mass spectrometrists and arranged meetings for many years. The BMSS was then registered as a charity in 1980, which required a stronger emphasis on education. Indeed, the importance of education is now encapsulated in the goals published on the Charity Commission website 'to promote and disseminate knowledge of mass spectrometry and allied subjects for the benefit of the public'. This simple, yet powerful, statement of intent required by the Charity Commission reveals much of what drives the BMSS in its activities. On reflection the activities of BMSS Education have built up over the years to cover a wide range of age groups, expertise and impact. The formal creation of Education Officer in 2004 ushered in a number of welcome initiatives in education including the BMSS Lecturer in 2006 and the Summer Studentships in 2007. Since those initiatives were first launched they have evolved into regular programmes that have run nearly every year. A worthy aspiration for BMSS Education is to support the next generation of mass spectrometrists and provide opportunities for people of all ages to explore and discuss mass spectrometry. The BMSS provide events, activities and resources for students, teachers and educators, scientists and the general public.

Education in mass spectrometry for all ages

Public Education

One of the amazing things about education in mass spectrometry is the range of backgrounds that is covered by people who use mass spectrometry. People who use mass spectrometry can vary from expert users with lifelong research projects eked out over decades to those who simply use mass spectrometers as an alternative detector in a chromatographic separation, or for a single analytical assay for a clinical or security application. The many activities of the BMSS and those mass spectrometrists that engage and reach out to others can reach everyone including children, artists, school pupils and world experts.

For wider general public engagement it can be challenging to demonstrate mass spectrometry since mass spectrometers have typically been large, expensive and rarely accessible. Demonstrations of elementary chemistry, biology and physics require few resources and are often very simple conceptually. Showing the power of analytical science using mass spectrometry can sometimes require significantly more resources and an understanding of many more scientific concepts. However it is increasingly recognised that public outreach and engagement with people from a variety of disciplines and backgrounds is key to making advancements in science and encouraging future students. Indeed many funding bodies requires a significant demonstration of engagement both in applications before activities commence and measuring the outcomes of engagement when an activity finishes. Put simply, in

bygone days people would chance upon mass spectrometry and realise it's relevance after much reading and effort. Nowadays a reasonable aspiration is that mass spectrometry should be an approachable subject and students should have access to it whenever possible. Later in this edition, Mass Matters features an interview with Giles Edwards (University of Manchester) who founded a charity that recycles donated mass spectrometry equipment and has presented a number of public talks on mass spectrometry.

Schools materials

At the youngest formal education level, for school children and teachers, mass spectrometry is often introduced as part of GCSE and A-level curricula alongside techniques like nuclear magnetic resonance (NMR) spectroscopy, infra-red spectroscopy and gas and thin layer chromatography. Some exam boards introduce the physics of moving ions with reference to one of the earliest forms of mass spectrometer, the Bainbridge mass spectrometer. Until recently the main secondary school syllabuses in the UK covered mass spectrometry using gas chromatography, electron ionisation and magnetic sector mass spectrometry. While magnetic sector instruments remain popular for niche applications, it is now undoubtedly less common than quadrupole or time-of-flight mass spectrometry. The recent change to teaching time-of-flight mass spectrometry is welcome, as the fundamental physics of this mass analyser is easy to conceptualise and demonstrate in common laboratories. The BMSS has provided notes, videos and links to more information for use in secondary schools by teachers and pupils for a number of years and a current initiative is seeking to update these notes to reflect current practice and the new range of instrumentation, ionisation methods and software.

Careers

In recent years the BMSS have scheduled a careers workshop at the British Mass Spectrometry Annual Meeting (in Manchester this year, 4th-7th September 2017, more info at www.bmss.org.uk) which has typically included a

number of speakers sharing their experiences both in academia and industry with a wide range of applications from food and the environment to proteomics. These brief talks, illuminating critical decisions or opportune moments, can help inspire people to opt to

learn new techniques or consider new directions in their research and careers. There are plenty of chances to ask questions and the specialist recruitment company for analytical scientists, VRS Scientific Recruitment, have typically given a talk on their perspective of

careers and desirable qualities for mass spectrometrists and how to approach job applications and building skills and networks to enable career progression.

Introduction to MS course

The Introduction to MS course has been running since the early 1990s initially at the University of Cambridge. Indeed, the writer was one of the participants back in 2003 at Robinson College, University of Cambridge where Dr. Mark Harrison (formerly of Thermo Scientific) was one of the tutors, and was proud to recently present alongside Mark in 2016 after a good number of years. Whilst it didn't all sink in immediately in 2003 it was certainly a great introduction to specialising in mass spectrometry and the many possibilities that existed. The BMSS has been very lucky to have many great speakers at the Introduction to MS course. In 2016 the course was held in the preceding two days to the annual meeting and organised by Dr. Mark Harrison with speakers including Dr. Jackie Mosely (University of Durham), Prof. Mike Morris (Waters Corp & Imperial College), Prof. Rainer Cramer (University of Reading), Chris Mussell (British Museum, formerly LGC) and Ken Brady (Agilent). Whilst the travel chaos of Southern trains and unusually balmy summer's days in Eastbourne tested the schedule all talks were delivered to a great reception and the course feedback was unanimous in approval. The talks were arranged with parallel clinics that offered the opportunity to ask questions, large or small, on the topic of the lectures or on a general query. The parallel clinic sessions were often very busy and speakers kindly gave up their time far past the time the sessions had finished and picked up conversations in the refreshment breaks, which is a good sign that this informal approach to learning is well regarded, and indeed works! This year in 2017 the Introduction to MS course takes place at the Royal Northern College of Music, Manchester on the 4th and 5th September 2017. Read the boxed text (right) to find out more, and sign up at www.bmss.org.uk

SHORT COURSE 2017

Royal Northern College of Music, Manchester.

4th-5th September 2017. In association with the 38th BMSS Annual Meeting

Course Overview: This course covers the fundamental aspects of mass spectrometry, assuming an undergraduate level of basic science, but requiring no previous knowledge of the technique or practical experience of mass spectrometry. We will introduce you to the basic concepts and terminology of mass spectrometry. Learn about the most important ionisation techniques used in mass spectrometry such as electron ionisation, a range of atmospheric pressure ionisation techniques, some of the more recent ambient ionisation/direct analysis techniques and matrix-assisted laser desorption/ionisation. Discover how mass analysers work, including quadrupoles, ion traps, time-of-flight and Fourier transform mass spectrometers (Orbitrap and FT ICR), plus how hybrid mass spectrometers enable you to design the widest range of MS experiments to solve your analytical problems: from compound characterisation to quantification.

Using relevant, real-world examples such as common drugs and clinically relevant analytes, the course will illustrate both qualitative and quantitative applications of mass spectrometry. Inter-dispersing lectures with fully interactive workshops to work through example datasets, experimental workflows and demonstrating examples of best practice, will provide you with the confidence and tools to take back to your own lab.

Who should attend: Novices to mass spectrometry who wish to gain an understanding of the technology and an awareness of the vast field of applications, and current users who would like a refresher of the theory and to keep abreast of recent developments and advances.

The BMSS Lecturer

The BMSS Sponsored Lecturer enables an expert in mass spectrometry to represent mass spectrometry and the BMSS in an epic tour of the United Kingdom, and budget allowing, conferences abroad. The idea of the sponsored lecturer is to reach audiences that may not utilise mass spectrometry routinely and to act as an ambassador for the BMSS. The lecturees are high impact, with a focus on cutting-edge research and applications. The BMSS Lecturer has

given over a dozen lectures per year journeying all over the UK by planes, trains and automobiles. Institutions can select from a choice of two to three titles. There have been four BMSS Lecturers. The first BMSS Lecturer was Prof. Malcolm Clench (Sheffield Hallam University) who gave insights into cutting edge mass spectrometry imaging using matrix assisted laser desorption/ionisation. The second BMSS Lecturer was Prof. Frank Pullen (University of Greenwich) who brought a strong

emphasis on small molecules in drug discovery to the lectures. Proteins, peptides and oligonucleotides were a fascinating part of drug discovery but Frank shared his widespread experiences of how small molecule mass spectrometry had evolved in the pharmaceutical industry. Recent research into understanding collisional induced dissociation processes including a consideration of thermodynamics using quantum mechanics and density functional theory was presented. Recently Prof. Mike Morris (Waters Corp. and Imperial College) presented a number of

lectures from fundamentals of TOF, quadrupole and magnetic sector to stacked ring ion guides and the clinical application of mass spectrometry and the revolution that has kickstarted in biomedical applications. Currently Prof. John Langley (University of Southampton) has been travelling the UK to present a series of lectures on supercritical fluid chromatography, prediction in mass spectrometry and the analytical challenges of biodiesel with recent visits including the University of Edinburgh and University of Lincoln.