OCTOBER 2020 # 91

the Analytical Scientist®

Around the World in 60 Scientists

Welcome to The Power List 2020! Grab your virtual passport and join us in celebrating 10 analytical movers and shakers from each continent.

16 – 40

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A World-Class Celebration

A few words on the significance of The Power List 2020

It's the Power List, but not as we know it…

Allow me to introduce "Around the World in 60 Scientists" – a Power List that shares the stories of 10 leading analytical minds from each of our planet's major continents. Our rationale: to disrupt the status quo of previous lists, which have been heavily skewed towards Europe and North America.

After all, the analytical community is much more than the scientists operating in these regions. It's a diverse collection of gifted individuals working tirelessly towards a common goal: to improve the condition of our species, one analysis at a time.

Our 2020 List celebrates this diversity and boasts many new names, which is no surprise when you crunch the associated numbers (see pages 6 and 7). Of note, 55 percent of nominations in 2019 were for European scientists; this year that number was around 30 percent. We also received just one nomination for scientists in Africa in 2019, but we hit 13 percent in 2020. Interestingly, the change in emphasis also affected the diversity of nominations for Europe and North America.

As last year's Number One Jonathan Sweedler writes on page 14: "Potential biases are not unique to the Power List and, unfortunately, they can influence many forms of scientific recognition. As a discipline, we need to do better." I wholeheartedly agree with Jonathan, and I'm extremely happy with what we've accomplished.

But that's not to say it was without its challenges – nor is it to say the List is definitive (something we make clear every year). As always, those on the List had to be nominated by our readers – and nominations for some continents came much more readily than others (which led to some intense networking by yours' truly). Next came the challenge of obtaining responses from analytical scientists operating across the globe during a pandemic – no small feat, but the new friends we made along the way were more than worth the effort!

Increasing the visibility of underrepresented groups is important. As American civil rights activist Marian Wright Edelman said, "You can't be what you can't see." I cannot think of a more apt way to celebrate "power" in analytical science than by providing a platform to more evenly distribute it. In this sense, perhaps our 2020 List is more powerful than its predecessors... Whatever your thoughts (do let me know), I hope you enjoy reading the insightful, thoughtful, and sometimes quirky responses from our 60 sensational scientists.

Matthew Hallam
Editor

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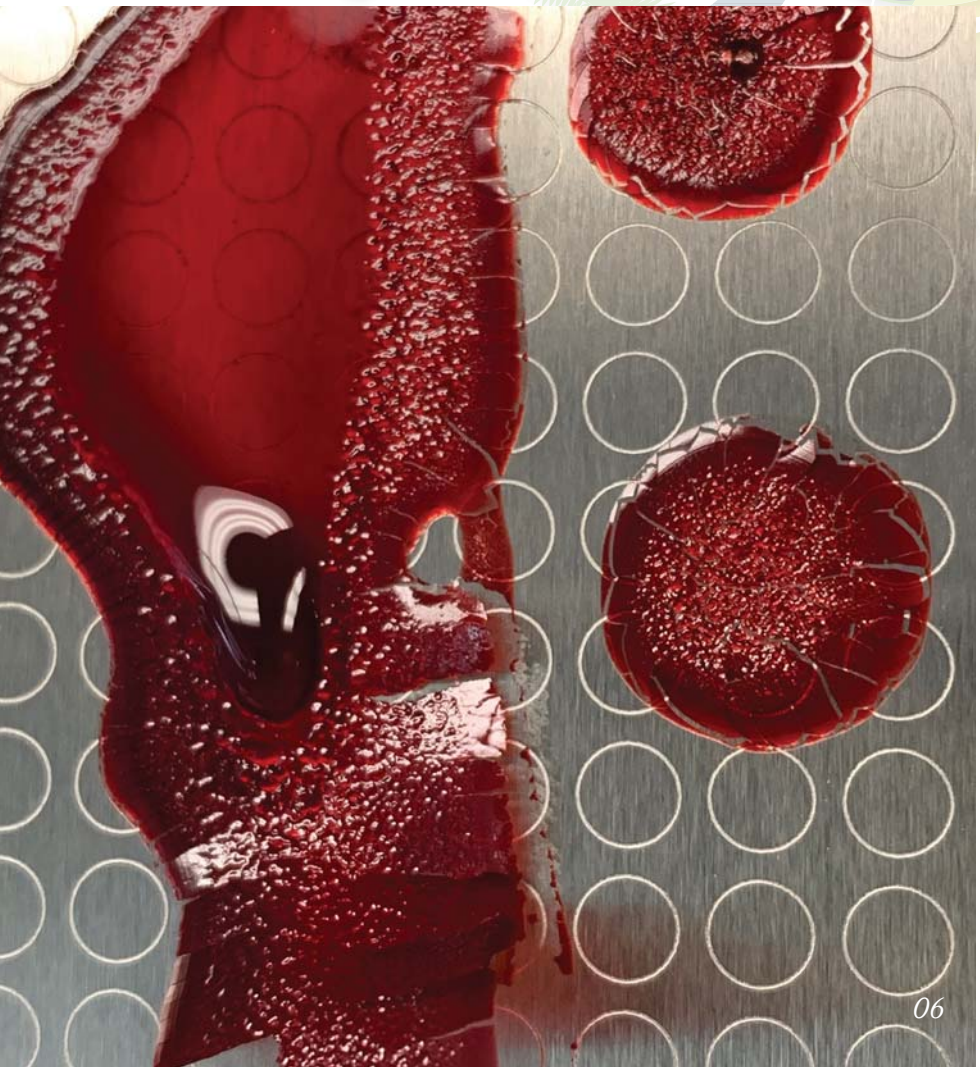

On The Cover

A fun graphic that epitomizes our mission for The Power List 2020: to shine a spotlight on the fantastic work analytical scientists are conducting around the world

Features

Departments

Sitting Down With

the Analytical Scientist

ISSUE 91 - OCTOBER 2020

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Upfront

Research
Innovation
Trends

Catching Crooks Red-Handed

MALDI-MS and a new chemical washing technique may enhance the study of bloody fingerprints

Fingerprints have sealed the fate of many a criminal. Take the case of the "Night Stalker," for example. The Stalker claimed 13 lives during a 14-month crime spree in 1980s Los Angeles. More deaths were expected – until a fingerprint on a mesh window screen allowed police to identify the culprit as Richard Ramirez. He was sentenced to death.

But fingerprints cannot be analyzed when covered with blood – a problem at gruesome crime scenes. "Current forensic protocols instruct practitioners to collect blood evidence by scraping dried bloodstains with a scalpel or swabbing," explains researcher Kristen Yeh. "This can destroy fingerprint ridge characteristics, resulting in loss of evidence."

Kristen's team have been searching for a way to overcome this limitation and may have come up with an answer. "We employed a dilute solution of EDTA (an anticoagulant) to wash blood from the fingerprint surface," Kristen explains. Once blood was removed, high-resolution MALDI-MS imaging was applied to assess the chemical composition of washed fingerprints. Why was MALDI-MS their weapon of choice? Kristen highlights the technique's minimally destructive nature and its extreme sensitivity and ease of use. In fact, MALDI-MS is compatible with some existing fingerprint development methods.

Once washed, the spatial distribution of chemicals in the fingerprints was compared with that of unwashed fingerprints – and slight differences emerged. "Although this did not limit our ability to use powder enhancers, it is possible that it will limit the success of enhancing washed fingerprints by chemical development," Kristen explains.

Nonetheless, she believes that their washing protocol could prove useful for studying evidence seized at crime scenes in the future. "Our method is best suited to non-porous materials (such as glass, metal, and tile) with smooth surfaces, and may help us obtain biological evidence from objects like knives on which blood and fingerprints are often found." The team are now planning proof-of-concept studies to test this theory.

Reference

1. *K Yeh et al., Forens Chem, 20, 100274 (2020). DOI: 10.1016/j.forc.2020.100274*

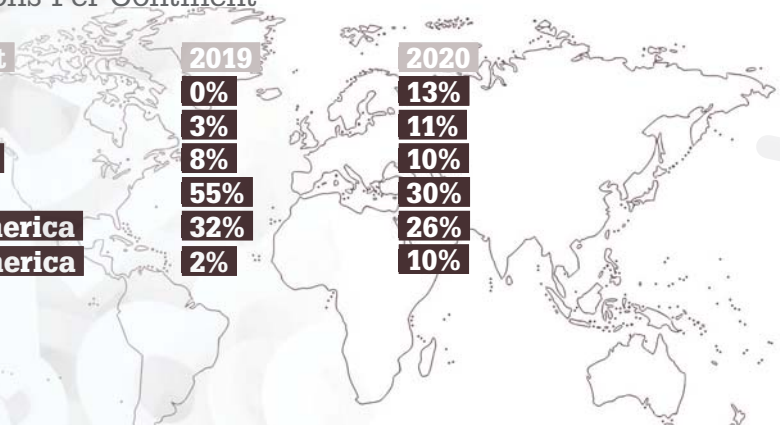
INFOGRAPHIC

The Power List in Numbers

Just some of the stats behind our two most recent Power Lists

Nominations Per Continent

Continent	2019	2020
Africa	0%	13%
Asia	3%	11%
Australia	8%	10%
Europe	55%	30%
North America	32%	26%
South America	2%	10%



BUSINESS IN BRIEF

A round-up of the latest business news in analytical science, from a program that promises to accelerate drug development to new product launches

- RESOLUTION Spectra Systems has recently been acquired by Merck, adding the company's Raman spectroscopy sensors to Merck's established bioprocessing portfolio. The acquisition is said to be in response to the move towards digitalization in the biopharmaceutical industry.
- A new partnership between Bruker and Purity-IQ combines Bruker's NMR-based screening and Purity-IQ'S genomics capabilities to offer traceability and identity testing throughout the cannabis supply chain.
- MOBILion Systems, Inc. has successfully raised $35 million in a second funding round for its proprietary ion mobility separations technology. SLIM (Structures for Lossless Ion Manipulation) can rapidly analyze challenging molecules, offering potential benefits to the pharmaceutical industry.
- Thermo Fisher is partnering

MilliporeSigma

with a number of CROs to offer pharma and biotech companies more accessible cryo-EM services. "We hope this program will enable cryo-EM for the masses," said Denis Zeyer, chief executive officer of CRO NovAliX.

- Following acquisition of KnowItAll informatics spectroscopy software and spectral databases earlier this year, Wiley has announced the debut of KnowItAll 2020. This new product features tools to accelerate the spectral analysis of unknown compounds and offers drug classification via infrared spectroscopy.

References

1. *Merck (2020). Available at: https://bit.ly/3mdNHj5*
2. *Bruker (2020). Available at: https://bit.ly/2FbI5VX*
3. *Mobilion Systems (2020). Available at: https://bit.ly/32kpjnL*
4. *Thermo Fisher (2020). Available at: https://bit.ly/2ZpE8U8*
5. *Wiley (2020). Available at: https://bit.ly/2RcDJjH*

A Dog's Dinner

Ever wondered what your dog looks for in its dinner? GC-MS may have an answer...

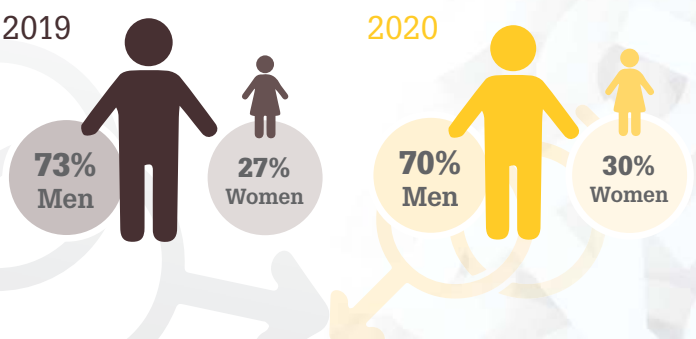
Dogs aren't the pickiest eaters, but some delicacies are more appealing to your pooch than others. Ever wondered why? Ming Yen and colleagues did – and they employed a band of beagles to find out.

The team fed the dogs six different foods, of which three seemed substantially more desirable than the others. Next: distinguishing which odors dictated the dogs' decisions. To this end, the researchers identified 55 volatile compounds using headspace solid-phase microextraction GC-MS. Correlation analysis linked nine of these compounds to increased food palatability among the beagles.

A preference test then identified three highly favorable components of canine cuisine: (E)-2-decenal, 2-furfurylthiol, and 4-methyl-5-thiazoleethanol. The team hope this knowledge will help dog food manufacturers increase the desirability of future products. In the meantime, why not treat your pooch to (E)-2-decenal, 2-furfurylthiol, and 4-methyl-5-thiazoleethanol in gravy this evening?

Reference

1. *M Yin et al., J Agric Food Chem, 68, 9195 (2020). DOI: 10.1021/acs.jafc.0c03088*



Awash with Apparel

Your favorite blue jeans are polluting the world's oceans with tens of thousands of microfibers per wash

Most of us are well aware of the polluting power of synthetic microfibers in the environment. Well, there's more bad news: natural fibers like cotton – previously thought (or hoped) to be innocuous – could also be having a deleterious impact.

While discussing the types of fibers cropping up in their samples, a team of environmental scientists from the University of Toronto found there was a common thread (pardon the pun): an abundance of cotton fibers coated with indigo dye. But where were they coming from? The team wondered if our precious blue jeans might be the source – and they set out to investigate.

The researchers started with sediment samples from different habitats, including the deep-sea Arctic, shallow suburban lakes around Toronto, and the Huron and Ontario Great Lakes. They used a combination of microscopy and Raman spectroscopy to analyze the chemical composition of the fibers found. "We also ran controlled washing experiments to see if the fibers shed from blue jeans corresponded physically and chemically to those we were finding all over the environment," says Samantha Athey, co-lead author of the paper.

Most of the microfibers they documented in the environment were not plastic, but anthropogenically modified cellulose – in other words, cotton or rayon fibers modified with chemical additives like dyes. They also showed that one pair of jeans can release a staggering 56,000 microfibers per wash. "This finding highlights the importance of investigating the fate and impacts of non-plastic fibers, which have historically been neglected in microfiber research," says Athey.

The takeaway? "Wash your jeans less!" says Athey. "We are not recommending people stop wearing their favorite pair of jeans, but manufacturers themselves suggest only washing your jeans monthly, and if you're in the market for a new pair then consider going second-hand – these shed less than new jeans and can also help fight the global textile waste problem."

Reference

1. *Samantha N Athey et al., Environ Sci Technol Lett (2020). DOI: 10.1021/acs.estlett.0c00498*

Deep Sea Supernovae

Researchers have found evidence of ancient star explosions in deep-sea sediments

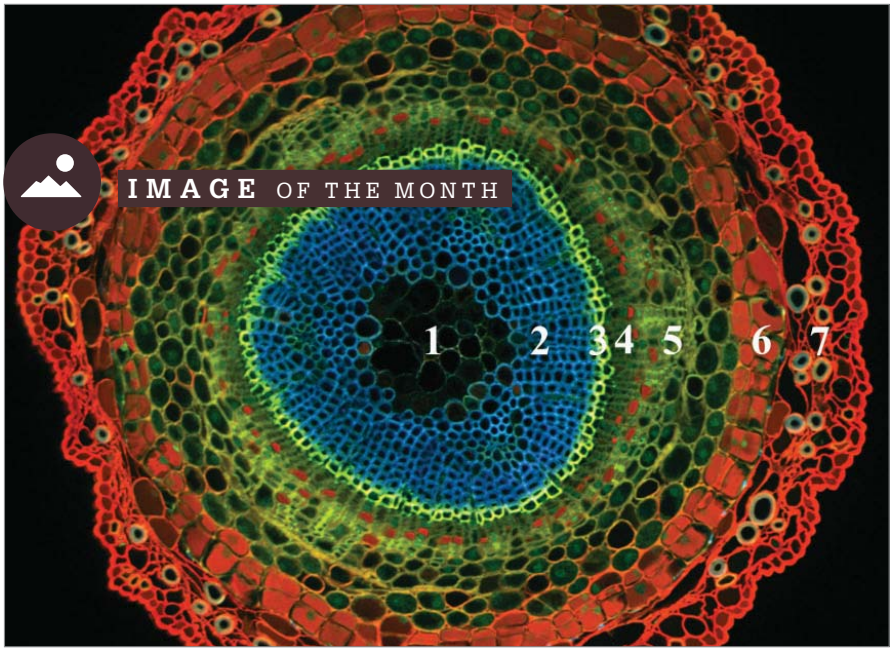
Our solar system has been traveling through the local interstellar cloud (LIC) for the last few thousand years – but where did the LIC come from?

To plumb the depths of the mystery, researchers at the Australian National University Heavy Ion Accelerator Facility used accelerator MS to analyze deep-sea sediment samples spanning the last 33,000 years. They found that iron-60 – a radionuclide formed by exploding stars – was present throughout the samples, but at a low concentration and with no discernible change in the pattern over time.

More research is needed, but this discovery offers an early indication that the LIC did not arise from a single, recent, nearby supernova. In fact, its iron-60 dust particles could represent "echoes" of numerous other star explosions millions of years old.

Reference

1. *A Wallner et al., PNAS, 117, 21873 (2020). DOI: 10.1073/pnas.1916769117*



Sapling Secrets

Little is known about the microscopic tissues guiding tree seedling growth. That's why researchers applied synchrotron X-rays to study cross-section images of ponderosa pine seedlings (photographed above). They found that the seedlings' xylem (tissue that acts as a circulatory system for plants – labelled 1) didn't dehydrate as expected, but surrounding tissues did. This highlights the sensitivity of xylem-adjacent tissues to dehydration in early seedlings – a surprise finding for the researchers.

Image credit: Megan L Miller, University of Idaho

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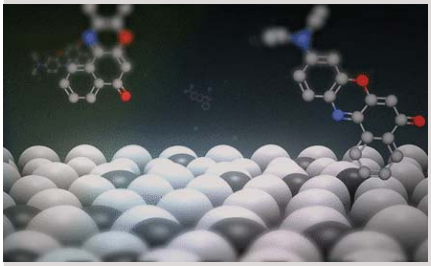
QUOTE OF THE MONTH

"This year, The Analytical Scientist team have striven to make the list more inclusive, specifically addressing issues with regional underrepresentation. They selected a judge from each continent, received multiple nominations from each (except Antarctica, which is not too surprising), and recognized individuals from multiple geographic regions. I applaud their efforts."

Jonathan Sweedler, Editor-in-Chief, Analytical Chemistry, and Director, School of Chemical Sciences, University of Illinois at Urbana-Champaign, USA.



Close to the Edge

A new single-molecule microscopy technique lets researchers see lipid membranes in unique detail

Using traditional techniques, such as MS, it's difficult for scientists to image cell membranes without destroying them in the process. Now, researchers have developed a new system – single-molecule orientation localization microscopy (SMOLM) – that is not only nondestructive, but provides a higher resolution view of lipid membranes than previously possible.

The clue is in the name: SMOLM visualizes the orientation and location of fluorescent probes. "Any fluorescent probe can be influenced by intermolecular forces from surrounding molecules," says Matthew Lew, principal investigator. "By measuring a single fluorophore's orientation within the membrane, we can sense its local environment – an ordered, solid-like lipid membrane will constrain it, whereas a liquid-like one leaves it free to rotate."

By collecting thousands of images and analyzing them with a unique algorithm, the team were able to resolve nanodomains and enzyme-mediated changes in lipid composition – a feat never achieved by conventional methods.

Reference

1. *Jin Lu et al., Angew Chem Int Ed, 59, 17572 (2020). DOI: 10.1002/anie.202006207*

the Analytical Scientist INNOVATION AWARDS

The Analytical Scientist Innovation Awards 2020

It's that time of the year again: TASIAs are back for 2020! Now's your chance to nominate the latest and greatest technology, instruments, and software making waves in the analytical science community – and beyond.

Last year's Innovation Awards winner: Solvere Carbon Selective Detector for HPLC – the world's first universal flame ionization detection (FID) for HPLC – produced by Activated Research

For the uninitiated, our Innovation Awards are an annual celebration of (you guessed it…) innovation within the analytical science community. Breakthroughs are nominated by our audience and ranked by an independent panel of esteemed judges. Winners are awarded one of 15 coveted spots in our special December feature.

Do you know of a product worthy of being a winner in 2020?

Nominations for the Innovation Awards are welcome from individuals, groups, or organizations. There's an online form – https://bit.ly/3iHlOgY – or you can send the following information to me at matthew.hallam@texerepublishing.com.

- The name of the innovation
- When it was launched (must be after October 2019)
- The name of the company, institution or university responsible
- A brief description (~10 words)
- A more detailed description, with an emphasis on what makes the product so innovative (~150 words)
- The potential impact of the product (~50-100 words)
- A photograph of the innovation

The deadline for entries is October 27, 2020, and 15 winners will be selected for 2020. The panel's decision is final and no correspondence regarding their deliberations or the final list will be entered into.

In a year of virtual conferences and limited opportunity to see innovations with our own eyes, we look forward to receiving your nominations!

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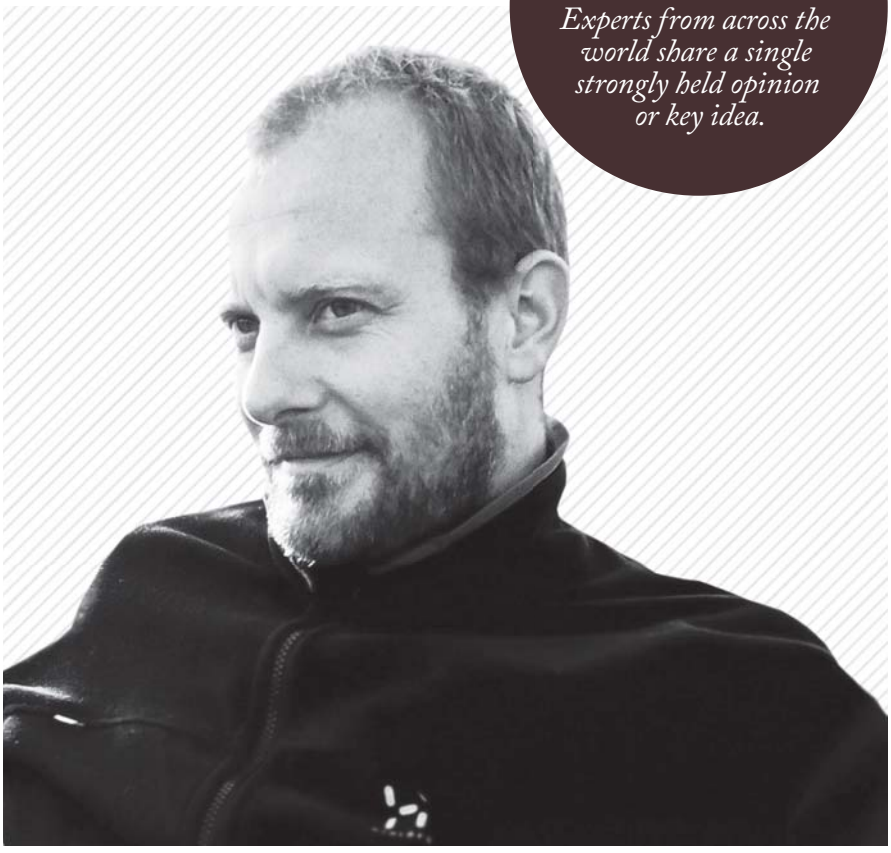
In My View

Experts from across the world share a single strongly held opinion or key idea.

The Mass Spec COVID Check

MS could be key to improving COVID-19 testing accuracy and capacity

By Maarten Dhaenens, Faculty of Pharmaceutical Sciences & ProGenTomics, Ghent University, Belgium



Rising population density, global mobility, and insufficient health care in poor countries all contributed to the rapid spread of COVID-19. Testing is crucial to fight the SARS-CoV-2 virus, and now is the time to prepare for future outbreaks. It's my view that MS could be employed to provide faster and cheaper diagnosis in the case of such events.

Diagnostic tests recognize unique molecular signatures from pathogens. These may take the form of small molecules or macromolecules (nucleic acid chains, proteins, carbohydrates, or lipids). DNA and RNA represent obvious targets because of our long-standing ability to amplify signals by PCR. Millions of PCR-based tests are performed each day. Although these are efficient, automatable, and acceptably cheap, the world cannot rely on one technology alone. Not only are reagents in short supply, but the test is also difficult to validate, and false results (positive and negative) may go undetected.

There is a need for an orthogonal diagnostic test that targets a different biomolecule. Like many other viruses, SARS-CoV-2 produces virus-like particles (VLPs) that contain proteins, but no RNA. These are attractive targets, and have been historically targeted using antibodies. However, these antibodies are expensive – and they come in various flavors that each yield slightly different results.

So we set out to analyze SARS-CoV-2 proteins by MS. Within two weeks, we had identified 17 peptides that were readily detected from nasal swabs by clinically applicable tandem quadrupole instruments. Sample preparation for protein detection is faster (taking less than 20 minutes) and cheaper (using under $5 worth of reagents) than that for RNA (which takes hours and costs $20 to $30 per sample), and it uses readily available reagents. Tandem quadrupole MS is also in routine use in the clinic – these instruments can be found in academic and industrial settings in cities around the world.

But MS instruments are much more diverse than quantitative PCR instruments, which complicates method standardization. To address this issue, we approached the challenge as a community, seeking help from MS vendors (including the Waters Corporation's COVID-19 Innovation

"But MS instruments are much more diverse than quantitative PCR instruments, which complicates method standardization."

Response Team and Sciex), as well as over a dozen academic labs in a consortium called Cov-MS. By providing them with an SOP – an open-source software template containing all the target peptides (Skyline) and a sample kit containing recombinant viral proteins – these groups were able to efficiently select the best targets for analysis. In parallel, we also analyzed patient samples. We showed that protein signal intensity correlates well with diagnostic (Ct) values from PCR-based tests. MS may thus make a valuable addition to the short-term testing toolbox.

Two main challenges remain. First, MS samples must be measured consecutively instead of in parallel. Our current analyses take eight minutes per sample, but Cov-MS consortium members at Alderley Analytical have achieved this in two minutes – this could mean over 700 patient samples a day! Acoustic Ejection MS could then increase this number to tens of thousands of patient samples a day. The second challenge is increasing sensitivity. We can already detect patient samples down to a Ct value of 25, but we believe that this sensitivity could be improved by up to four orders of magnitude using innovative enrichment approaches, such as peptide immunoprecipitation.

No one knows for sure when an MS-based test will be ready for the clinic, or even when the clinic will be ready for MS. But collaboration and data sharing is needed if MS is to rival PCR in terms of output and scale. Not trying would be nothing short of negligent.

Look to the Children

What can newborn screening approaches teach us about COVID-19 testing?

By Donald H. Chace, Chief Scientific Officer, Medolac Laboratories, Boulder City, Nevada, USA

Early disease detection leads to faster, more effective treatments and improved outcomes. These fundamental goals underpin newborn screening for rare inherited disorders. We can apply the lessons learned from more than a half decade of newborn screening to some of the issues surrounding infectious disease detection – specifically, COVID-19. Today, we undertake the public health mission of saving lives every day for hundreds of thousands of newborns. What can we, as analytical scientists, take from this work to improve our response to the current pandemic?

To answer that question, we must ask another: what are the key issues facing screening in healthcare? One is false results. To be useful in a public health screening environment, a method must have a target of zero false negatives and exceptionally low false positives. Furthermore, it must be able to test large numbers of samples accurately and precisely; it must be affordable to the consumer or payer; and samples collected must be adequate. What makes a sample adequate? It must be:

- the appropriate biological matrix of the target marker
- stable enough to meet the logistics of a large patient population
- accessible and readily available

"To be useful in a public health screening environment, a method must have a target of zero false negatives and exceptionally low false positives."

How can we possibly address all of these needs? Current newborn screening protocols provide an excellent model.

False results are a real issue for any test and their impact is often poorly understood. In clinical chemistry, a false negative or missed case is unacceptable. Without detection, there is no path to early intervention and treatment. Positive results are subject

to confirmation through additional screening or diagnostic tests. A true positive is usually confirmed by other information and by a clinical diagnosis; false positives cannot be confirmed and are ultimately categorized as normal.

Our methods have high sensitivity and specificity. For instance, in newborn screening, tandem MS replaced other methods because it was more accurate and precise in its measurements for many diseases. In fact, clinicians needed new action plans because a "presumed positive" was so much more likely to be a true positive and thus could be acted on while confirmatory testing was still underway.

There are many different COVID-19 tests with different rates of "false alarms" – understandable in an emerging disease with only a few months of research history. What matters is that clinicians and public health experts understand the accuracy of each test and communicate it well to patients. Ultimately, every COVID-19 test we have is a step along the path to a diagnosis. The diagnosis is made when we combine initial test results with confirmatory testing and the signs and symptoms of COVID-19.

"Our methods have high sensitivity and specificity."

It is the role of the analytical community to provide the best tools for screening and diagnostics, minimize false results, and ensure that the data generated lead to improved care. Looking at newborn screening is one way to better understand these principles and apply them to COVID-19 screening. It's my hope that, one day soon, we will be able to do for COVID-19 testing what we have achieved with newborn screening. In the meantime, I urge my colleagues to look to the children – because in our existing screening models may lie better solutions for COVID-19.

A "New Normal" for the Power List?

Lists of achievements are fun to read, but we must make them representative and inclusive. Is the Power List 2020 there yet?

By Jonathan Sweedler, Editor-in-Chief, Analytical Chemistry, and Director, School of Chemical Sciences, University of Illinois at Urbana-Champaign

I cannot help myself. I am drawn to rankings and lists, especially those related to analytical chemistry. I have always enjoyed looking over The Analytical Scientist's Power List, in whatever format it has appeared – including the Top 100, Top 50 Women, and Top 40 Under 40.

I am writing this piece ahead of publication of the 2020 Power List, "Around the World in 60 Scientists." Not only am I looking forward to seeing the results because I am a measurement scientist, but I am also interested to see whether the new format accurately represents the excellence in our field.

"We need to work toward more representative lists and awards in the future – our field will surely benefit if we do."

As some readers may know, I questioned whether the 2019 Power List fully represented our field at the time of publishing (1) – even though I was ranked Number One on said list. What were my concerns? Women made up only 27 percent of the list, with only three in the top 20. I also noted that

there was a lack of individuals from other underrepresented groups.

There were not enough scientists featured from Asian and Latin American countries. At a time when more than a third of the published analytical manuscripts are from Asia, I would expect similar numbers of scientists from this region to be included in a list designed to highlight "the tremendous range of talent, ingenuity, and leadership present across all corners of analytical science on a global scale." China, Japan, Korea, and other Asian countries host many world leaders in measurement science. But, with some notable (and deserved) exceptions, I felt they were underrepresented on the 2019 Power List. I also questioned whether all of those who should be recognized for making notable contributions to the field were included.

Were these issues related to the nomination process or underlying biases in our discipline? When I asked in 2019, I was told that there was a lack of diversity in the nominations received. Potential biases are not unique to the Power List and, unfortunately, they can influence many forms of scientific recognition. As a discipline, we need to do better.

This year, The Analytical Scientist team have striven to make the list more inclusive, specifically addressing issues with regional underrepresentation. They selected a judge from each continent, received multiple nominations from each (except Antarctica, which is not too surprising), and recognized individuals from multiple geographic regions. I applaud their efforts. But how can we gauge whether these efforts have been successful? The number of new faces on the list will surely be an indicator.

Moving forward, it is important that all of us think outside the box when nominating our colleagues for the Power List and myriad other chemistry awards. We need to work toward more representative lists and awards in the future – our field will surely benefit if we do.

Reference

1. *JV Sweedler, "Is the Power List a Representative List?," Anal Chem, 91, 23, 14783 (2019). DOI: 10.1021/acs.analchem.9b05155*

AROUND THE WORLD IN 60 SCIENTISTS

From the Amazon Rainforest to the Great Wall of China, analytical scientists hide in every nook and cranny of our wonderful world – and each has a story to tell. This year's Power List tells a handful of those stories (10 per continent, to be precise). And for those of you upset by the omission of Antarctica, we feel your pain – but we did give it a go!

AFRICA

ANDRÉ DE VILLIERS

PROFESSOR, STELLENBOSCH UNIVERSITY, SOUTH AFRICA

Future of the field: Looking back at the developments of the last 20 years, it is clear that predicting where we will be in 2040 is fraught with uncertainty. Nevertheless, I expect several current trends to be influential; two examples are the rapid development and increasing application of MS and the miniaturization of analytical instrumentation, including increasingly powerful portable devices. Furthermore, I expect that HPLC instrumentation 20 years from now will have moved on from the current modular design to accommodate more efficient column formats. Finally, I look forward to an increasingly important role for multidimensional chromatography and to developments in this field over the next two decades.

ANTHONY GACHANJA

PROFESSOR OF ANALYTICAL AND ENVIRONMENTAL CHEMISTRY, JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, NAIROBI, KENYA

Greatest inspiration: During my lectures at Hull, I interacted with our tutor, Professor Alan Townshend, who greatly inspired me through the deep knowledge he had on analysis at the time, the books he had authored and his networks in science locally and internationally. He made me ask myself if it was possible to take analytical science back to Africa with me.

Future of the field: In the coming decade, there will be an emphasis on taking the equipment to the field, rather than taking the sample to the lab, with more stable portable equipment with artificial intelligence to validate the data. These gadgets will go domestic, enabling people that need to know the levels of contaminants in water, air quality and the like to make decisions regarding their health or environmental conditions.

Misconceptions of science in Africa: Science is conceived as a foreign import in Africa. Science will be accepted when it works (or gives a solution), but will be quickly abandoned if it has the slightest level of doubt. An example is the traditional medicine and herbal medicine versus western medical practice. This may be attributed to the lack of good or modern science facilities located in Africa.

CATHERINE NGILA

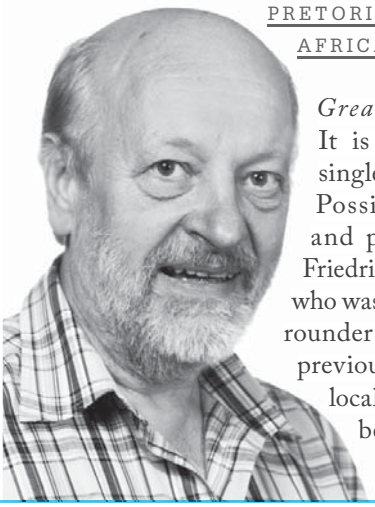
DEPUTY VICE CHANCELLOR, RIARA UNIVERSITY AND EXECUTIVE DIRECTOR, THE AFRICAN ACADEMY OF SCIENCES, NAIROBI, KENYA

Dinner party guest: Marie Maynard Daly. She was the first Black American woman to earn a doctorate in chemistry in 1947. Daly overcame the dual hurdles of racial and gender bias in pursuing university education in the 1930s and 1940s, conducting important studies on cholesterol, sugars, and proteins. In addition to her research, she was committed to developing programs to increase minority student enrollment in medical schools and graduate science programs. I feel a personal connection with Daly's dreams of helping Black students of her time because of my own desire to provide students in higher education institutions in Kenya (where most universities do not have well-equipped laboratories) with hands-on science experience.

Common misconceptions of science in Africa: That Africa cannot produce top scientists who can win Nobel Prizes. If scientists in Africa are exposed to the right infrastructure and an enabling environment, they can indeed produce great innovations – but this remains a challenge.

EGMONT ROHWER

PROFESSOR, DEPARTMENT OF CHEMISTRY, UNIVERSITY OF PRETORIA, SOUTH AFRICA



Greatest inspiration: It is very difficult to single out one person. Possibly the scientist and philosopher Carl Friedrich von Weizsäcker, who was one of the few all-rounder intellects of the previous century. More locally relevant it could be Kofi Annan for his firm belief that Africa has to develop by skipping a generation of technology to avoid repeating the mistakes of the western world.

Future of the field: The evolution of new analytical instrumentation and techniques is exponential. Analytical science will have a major influence on our understanding of inorganic and organic systems as improved methods allow us to investigate phenomena at an atomic and molecular level. It will revolutionize catalysis, renewable energy, storage systems, off-grid sustainable living, medicine, and our understanding of the immune system and perhaps even the human mind.

HARALD PASCH

PROFESSOR AND SASOL CHAIR IN ANALYTICAL POLYMER SCIENCE, DEPARTMENT OF CHEMISTRY AND POLYMER SCIENCE, STELLENBOSCH UNIVERSITY, SOUTH AFRICA

Reason for pursuing analytical science: As a PhD student I worked on a project that aimed to create new molecular structures using polycondensation reactions. I soon found that classical size-exclusion chromatography was not sufficient for a comprehensive analysis of these structures, and I started to make use of HPLC for chemical composition separation. Getting interested in the analytical method development itself, I moved from polymer synthesis to polymer characterization projects, ultimately finding myself doing research on the hyphenation and comprehensive coupling of fractionation and spectroscopic technologies.

Greatest inspiration: There have been a few mentors and colleagues that inspired me scientifically. Most of all I admired people that were able to combine scientific excellence with a strong talent in music and the arts, such as Leonardo da Vinci and Albert Einstein.

Time travel destination: I would go to Freiburg, Germany, in the 1920s to meet Hermann Staudinger (Nobel prize in Chemistry 1953), and to watch him arguing with the traditionalist organic chemists over the existence of macromolecules that we call polymers today.

Advice to younger self: Work harder on your research subjects. Allocate more time to play your favorite musical instrument.

LUCKY MOKWENA

DIVISIONAL MANAGER, CENTRAL ANALYTICAL FACILITIES, STELLENBOSCH UNIVERSITY, SOUTH AFRICA

Reason for pursuing analytical science: It all started during a grade 11 experiment in a science class. We were preparing esters from alcohols and carboxylic acids. I liked the ester smell we produced. I knew then that that's what I wanted to do. I also fell in love with GC after watching a scene in an episode of a forensics program. GC was used to determine whether a deceased person had taken any alcohol or drugs prior to death, as well as determining whether they had been poisoned.

Dinner party guest: The former state president of South Africa, Jacob Zuma. I am fascinated by his story. He was born in the rural town of Nkandla and lost his father at age four – and then went on to become president of the state. For someone who received no formal schooling to have achieved so much is amazing. I would like to ask what kept him motivated, among other things.

Misconceptions of science in Africa: Children growing up in rural areas of Africa think that science is a difficult subject and that it is meant only for the "smart" kids from the townships. Some Black children do not believe that they can reach the same heights as their white counterparts, but they can!

Nominator comment: He is a world-class GC-MS analyst who provides a cutting-edge service to industry, and he has been instrumental in helping many postgraduate students. I don't think he gets the credit he deserves.

LUKE CHIMUKA

PROFESSOR OF ENVIRONMENTAL ANALYTICAL CHEMISTRY, SCHOOL OF CHEMISTRY, UNIVERSITY OF THE WITWATERSRAND, SOUTH AFRICA

Greatest inspiration: My PhD supervisor Jan Åke Jönsson from Lund University, Sweden. He was an expert in fundamentals of analytical techniques, and this helped me to think outside the box in my research.
Misconceptions of science in Africa: This is perhaps not a misconception, but scientists are lowly paid in Africa when compared with other professions, especially in the private sector.
Advice to younger self: Always think outside the box. Never accept the status quo.

MADELIEN WOODING

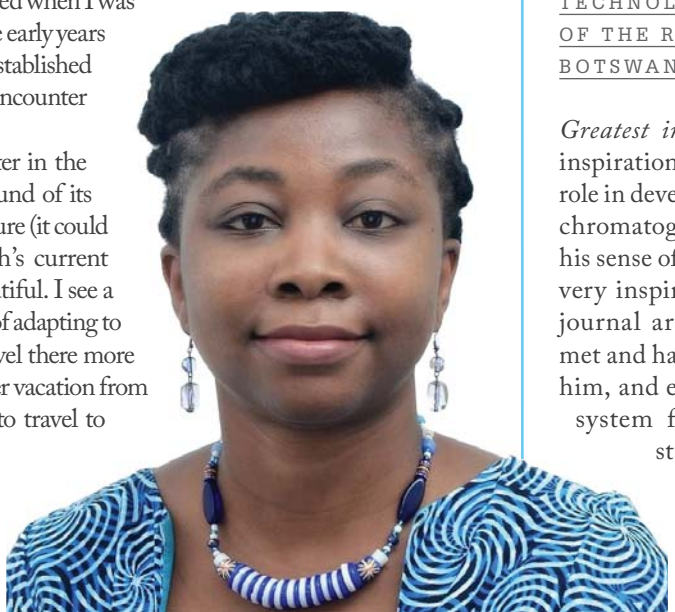
UPLC-IMS-HDMS FACILITY MANAGER, DEPARTMENT OF CHEMISTRY, UNIVERSITY OF PRETORIA, SOUTH AFRICA

Reason for pursuing analytical science: My first and foremost interest is in the field of chemistry. Chemistry provides us with the means, methodology, and understanding to investigate and solve some of the most pressing concerns of our time. Climate change, food safety, water quality, and the burden of disease are just some of the challenges we face. I made the choice to specialize in analytical chemistry because the field provided me with the tools to gather, communicate, and process important information on some of these issues.
Future of the field: MS is my passion and I can't wait to see what the future holds. It is already being used for forensic detectors, newborn screening tools, breath analyzers, and antibiotic resistance profiling. I predict that it will be used in even more fields, even by the layperson. Handheld spectrometers could be used for rapid disease screening. They could even be used at home to monitor water quality or test food for pesticides. Most importantly, I see new, expansive compound libraries, comprising vast arrays of compound information from various analytical sources, that will simplify the detection of unknown compounds.

MARIAN ASANTEWAH NKANSAH

ASSOCIATE PROFESSOR, DEPARTMENT OF CHEMISTRY, KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI, GHANA

Misconceptions of science in Africa: Some think that all scientists in Africa do mediocre research or lack appropriate equipment. There is also a general lack of trust in data generated in Africa; I've witnessed this myself in the time taken to review manuscripts and the comments I've received when I was studying for my PhD in Europe versus the early years following my return to Africa. Now I've established credibility in the field, I don't seem to encounter these biases as much.
Time travel destination: I'd travel to Jupiter in the far future – firstly because I love the sound of its name, secondly because of its massive nature (it could accommodate around 300 times Earth's current population), and thirdly because it is beautiful. I see a future where science has discovered ways of adapting to life on Jupiter – as well as methods to travel there more quickly. That way I could take my summer vacation from my earthly home in Kumasi in Ghana to travel to Jupiter for sightseeing and relaxation...



NELSON TORTO

PERMANENT SECRETARY, MINISTRY OF TERTIARY EDUCATION, RESEARCH SCIENCE AND TECHNOLOGY, GOVERNMENT OF THE REPUBLIC OF BOTSWANA

Greatest inspiration: My greatest inspiration was Pete Kissinger. His role in developments of a detector for chromatography was key, but also his sense of humour and passion was very inspiring, even from reading journal articles. I am glad that I met and had real conversations with him, and eventually bought a BAS system for my electrochemical studies in Botswana.

ASIA

BAOHONG LIU

PROFESSOR, DEPARTMENT OF CHEMISTRY, INSTITUTE OF BIOMEDICAL SCIENCES, FUDAN UNIVERSITY, SHANGHAI, CHINA

About: In addition to acting as a professor at Fudan University, Baohong also acts as an associate editor for the Analyst, where she welcomes submissions in analytical nanoscience, bioanalytical sensors, elecroanalytical chemistry, microfluidics and miniaturized devices, MS, and surface chemistry. Her contributions to the field have been recognized with a Science and Technology Award from the Chinese Ministry of Education in 2006, and the Excellent Young Scientist Grant from the National Nature Science Foundation of China in 2009.

Nominator comment: She is doing great work in bioanalytical chemistry, including biosensors based on functional interfaces, single-molecule detection, and micro-analytical systems.

GUOWANG XU

PROFESSOR OF APPLIED CHEMISTRY, CHINESE ACADEMY OF SCIENCES, BEIJING, CHINA

Reason for pursuing analytical science: Actually, it was very accidental. When I was preparing my master entrance examination form, Zhiqing Qi, my organic chemistry teacher, asked me who I had chosen as my supervisor. I told him about a petroleum chemist I selected. Prof. Qi then offered me some excellent advice: if you want to become a great scientist, you must become the student of a great scientist. And it's true that scientists who achieve greatness do so by following in the footsteps of giants. Thus, I selected Peichang Lu, a member of the Chinese Academy of Sciences and a pioneer of chromatography in China. I passed my entrance examination, joined Dalian Institute of Chemical Physics (DICP) of the CAS in 1984, and obtained my PhD in 1991. I have worked in DICP studying chromatography-MS and MS-based metabolomics in disease biomarker discovery, traditional Chinese medicines and food safety ever since.

Nominator comment: Addressing the technical challenges of chromatography-MS-based metabolomics in coverage, throughput, robustness, sensitive semi-quantitative analysis and the unambiguous structure elucidation for unknown metabolites, his lab has developed the world's leading platforms for metabolomics and lipidomics. He was the first to suggest pseudo-targeted metabolomics and modified metabolomics methods; the former has been published in Nature Protocols and used by many laboratories.

KOJI OTSUKA

PROFESSOR, DEPARTMENT OF MATERIAL CHEMISTRY, GRADUATE SCHOOL OF ENGINEERING, KYOTO UNIVERSITY, JAPAN

Reason for pursuing analytical science: I thought that analytical chemistry is both fun and important. Though it is one of the most basic fields in chemistry, no developments in chemistry would have been possible without analytical chemistry.

Greatest inspiration: Professor Shigeru Terabe. He was my supervisor in graduate school, and is known worldwide as the inventor of micellar electrokinetic chromatography (MEKC). He is gentle – but always strict about science.

Time travel destination: I'd go back to my studenthood in the graduate school of Kyoto University. I'd like to conduct extensive studies and research covering wider areas of chemistry.

Advice to younger self: There is no end-point for research. Do the best you can and work as hard as possible.

KENZO HIRAOKA

PROFESSOR, UNIVERSITY OF YAMANASHI, JAPAN

Nominator comment: Professor Hiraoka has made considerable contributions to analytical chemistry, particularly ambient ionization techniques. His pioneering research has led to the development of multiple novel ion sources, with probe electrospray ionization being perhaps the most successful. He is also a passionate scientist and a great mind, who is always keen to share his knowledge with colleagues and students. His research has been incredibly influential in the field of MS, and yet is arguably underappreciated – particularly outside of Asia.

MYEONG HEE MOON

PROFESSOR, DEPARTMENT OF CHEMISTRY, YONSEI UNIVERSITY, SEOUL, SOUTH KOREA

About: Myeong Hee Moon's group focuses on the development of separation methods based on field-flow fractionation. They use this technique alongside nanoflow LC and electrospray-ionization MS to aid in the discovery of biomarkers of human disease.

Nominator comment: Myeong Hee Moon has his expertise in field-flow fractionation for the separation of biological materials, colloids, macromolecules – as well as field-flow fractionation channel development.

TASNEEM KAZI

MERITORIOUS PROFESSOR, NATIONAL CENTER OF EXCELLENCE IN ANALYTICAL CHEMISTRY, SINDH UNIVERSITY, JAMSHORO, PAKISTAN

Nominator comment: Professor Kazi was a postdoctoral fellow in my laboratory some 35 years ago. At the conclusion of her fellowship, she returned to Pakistan and began her career as an assistant professor at the University of Sindh – her career there has been distinguished. In addition to publishing some 250 research articles and mentoring a-dozen-and a-half doctoral students, she's also raised two fine sons as a single mother after her husband passed away.

SHAOPING LI

DISTINGUISHED PROFESSOR AND DEPUTY DIRECTOR, STATE KEY LABORATORY OF QUALITY RESEARCH IN CHINESE MEDICINE, UNIVERSITY OF MACAU, ZHUHAI, CHINA

Reason for pursuing analytical science: Chinese medicine is a treasure of Chinese civilization and has played an important role in the development of the Chinese nation. However, its active ingredients are not clear and quality control is difficult. Analytical chemistry is conducive to promoting the research of traditional Chinese medicine.

Advice to younger self: To succeed, you need diligence and persistence.

Nominator comment: Professor Shaoping Li is an expert in herbal glycoanalysis and the development of quality control methods for Chinese medicines.

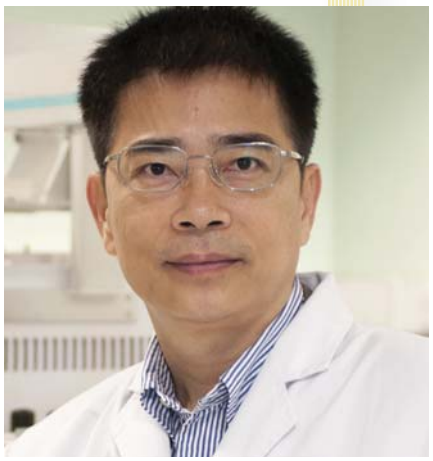
YI CHEN

CAS KEY LAB OF ANALYTICAL CHEMISTRY FOR LIVING BIOSYSTEMS, INSTITUTE OF CHEMISTRY, CHINESE ACADEMY OF SCIENCES, BEIJING, CHINA

Reason for pursuing analytical science: I majored in inorganic chemistry and was very much interested in material science at that time. Later, I was fascinated by the chemical mystery that drives a living being and started to develop methods to study living cells, insects, and plants, including capillary electrophoresis, surface plasmon resonance sensing and imaging, and bio-MS. This led to my founding and serving as the first director of the Key Laboratory of Analytical Chemistry for Living Biosystems in 2009.
Nominator comment: Yi Chen has expertise in capillary electrophoresis, surface plasmon resonance sensing and imaging, and MS, with more than 300 authored and co-authored publications, three books, and over 35 patents. He has been working on capillary electrophoresis for the study of living cells, proteins, carbohydrates, DNA, and small ionic species since 1984. His group recently achieved capillary electrophoresis of hemoglobin chains for thalassemia diagnosis.

ZONGWEI CAI

KWOK YAT-WAI ENDOWED CHAIR IN ENVIRONMENTAL & BIOLOGICAL ANALYSIS, CHAIR PROFESSOR OF CHEMISTRY, AND DIRECTOR OF THE STATE KEY LABORATORY OF ENVIRONMENTAL & BIOLOGICAL ANALYSIS OF HONG KONG BAPTIST UNIVERSITY, CHINA



Reason for pursuing analytical science: I became interested in analytical chemistry after learning about MS in an undergraduate course of "Instrument Analysis" at Xiamen University in 1981. Moving onto my PhD in Germany, postdoc in the United States, and my later career in Hong Kong, I have experienced working as an environmental, pharmaceutical, and biological analytical scientist with great joy.
Future of the field: Mass spectrometers will become part of our daily lives – like cars, for example. This will be useful for environmental and food safety applications, and even disease diagnosis.
Advice to younger self: You must have a strong interest in what you do. As an analytical chemist, innovation and multidisciplinary research are particularly important. Research focus is of course necessary, but interest and motivation may also come from the needs of the community – and society as a whole.

YI-TAO LONG

CHANG JIANG SCHOLAR, SCHOOL OF CHEMISTRY AND CHEMICAL ENGINEERING, STATE KEY LABORATORY OF ANALYTICAL CHEMISTRY FOR LIFE SCIENCE, NANJING UNIVERSITY, CHINA

About: Yi-Tao's research focuses on the development of electrochemical measurement methods to analyze the characteristics and dynamics of individual molecules, nanoparticles, and cells – pushing the limits of detection to the single-molecule level.
Nominator comment: Yi-Tao has made pioneering contributions to nanopore electrochemical measurement. He has published over 300 peer-reviewed scientific papers in high-impact journals, as well as three books and 37 patents; he has been cited over 11,000 times. What's more, his research has been recognized with many awards, including first place in the Science and Technology Award of the China Administration for Instrumental Analysis, and the Liang Shuquan Award for Basic Research in Analytical Chemistry. He now acts as an associate editor for Chemical Science and Research and is an elected Fellow of both the Royal Society of Chemistry and the International Society of Electrochemistry. In short, his outstanding contributions to the field can be summarized in the following three breakthroughs: single-molecule analysis by nanopore interface, low-noise, high-bandwidth instruments for nanoelectrochemistry, and electrochemical sensing and imaging of single nanoparticles and cells.

AUSTRALIA

ANTHONY PURCELL

HEAD OF THE IMMUNOPROTEOMICS LABORATORY AND DEPUTY HEAD OF THE DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY, MONASH UNIVERSITY, MELBOURNE, AUSTRALIA, AND VICE-PRESIDENT OF THE AUSTRALIAN PROTEOMICS SOCIETY, AUSTRALIA, AND COUNCILLOR OF THE HUMAN PROTEOME ORGANIZATION, CANADA

Reason for pursuing analytical science: I have always been interested in how things work and was constantly pulling appliances apart as a kid – and (sometimes) successfully rebuilding them. That is essentially what I do now – but at the molecular level! I always tell my students that mass spectrometers never lie – they are just often misinterpreted. I love the purity of the data and the excitement of identifying something totally novel.
Misconceptions of science in Australia: Australian science has always punched above its weight. We have a relatively small, but dynamic and innovative community in the analytical sciences and a proud tradition of MS and its application to the life sciences.

EMILY HILDER

DIRECTOR, FUTURE INDUSTRIES INSTITUTE, UNIVERSITY OF SOUTH AUSTRALIA

Reason for pursuing analytical science: I was not motivated to become an analytical scientist in particular, but I wanted to become a scientist in general once I realized that it was an inherently creative pursuit. It's the opportunity to exercise creativity every day that still excites me.
Future of the field: I expect the limits of analytical separations to continue to be challenged with smaller, faster, autonomous devices leading to real-time, in situ analysis. I also hope that we will see a shift to more sustainable, greener and ultimately zero-waste analytical systems.

DEBBIE SILVESTER-DEAN

ASSOCIATE PROFESSOR, SCHOOL OF MOLECULAR AND LIFE SCIENCES, CURTIN UNIVERSITY, PERTH, AUSTRALIA

Advice to younger self: Have more confidence and don't be afraid of failure! Often, you come through school and don't experience failure (at least, I can't recall that I ever did). However, an academic job is a bit like an iceberg; 10 percent are the successes that go on your CV and 90 percent are the unsuccessful job applications, award nominations, grant proposals, rejected journal articles. I would advise my younger self to not give up and be dejected at failures – use it as a learning experience and move on to the next project, until you get that success that builds you up.

GAVIN REID

PROFESSOR OF BIOANALYTICAL CHEMISTRY, SCHOOL OF CHEMISTRY AND DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY, UNIVERSITY OF MELBOURNE, AUSTRALIA

Reason for pursuing analytical science: I grew up on a farm, working with my hands, and have always had the curiosity to understand how things work. However, despite having interests in chemistry and biology in school, I wasn't a great student, so my first job was as a junior research assistant in a cancer research lab. After a few years working there, my boss gave me the responsibility of setting up what was only the second ESI mass spectrometer in Australia at the time for peptide sequencing applications. After that, I was hooked.

Greatest inspiration: Early in my career, I was mostly inspired by the passion for discovery – to turn over rocks to find out what's underneath – a curiosity that was instilled in me by many formal and informal mentors. Nowadays, I'm inspired on a daily basis by seeing my students have those "Aha!" moments in the lab or in class, and when they come to me with their new and exciting research results.

Misconceptions of science in Australia: That because scientific ideas change as new evidence comes to hand (as we've seen with climate change or during the current COVID-19 global pandemic), scientific data and scientists can't be trusted.

Advice for younger self: "Life moves pretty fast. If you don't stop and look around once in a while, you could miss it." - Ferris Bueller

JEREMY NICHOLSON

DIRECTOR OF THE AUSTRALIAN NATIONAL PHENOME CENTRE AND PRO-VICE CHANCELLOR OF HEALTH SCIENCES, PROFESSOR OF MEDICINE, MURDOCH UNIVERSITY, AUSTRALIA, AND EMERITUS PROFESSOR OF BIOLOGICAL CHEMISTRY, IMPERIAL COLLEGE LONDON, UK

Greatest inspiration: There are a lot to choose from! If you study science broadly, like I do, you pick up inspiration and philosophy from many sources. My favourites are Jacob Bronowski and Richard Feynman – both physicists/mathematicians with complex, fascinating life stories and a strong interest (and astonishing insights) in humanistic philosophies. The 1970s BBC TV documentary series The Ascent of Man, hosted by Bronowski, is still a masterpiece and is highly relevant now. It has had a strong influence on the way I think about science and the problems of the world.

Future of the field: I'm not sure anyone can have a clear line of sight on that, irrespective of field. The last few months of the COVID-19 pandemic have shifted societies and world economies beyond all recognition. This disease (and others to follow) will dominate medicine and healthcare for decades to come because of its complexity and long-term effects. Analytical science is one of the most important weapons against this disease, because new methods are needed to test, trace, predict severity, monitor therapeutics' efficacy, and assess long-term population effects and disease risk changes. Our Phenome Centre, and others like it, will be busy for many years fighting this pandemic and preparing for the next one. We analytical scientists have our work cut out!

JESSICA PANDOHEE

RESEARCH FELLOW, CENTRE FOR CROP AND DISEASE MANAGEMENT, SCHOOL OF MOLECULAR AND LIFE SCIENCES, CURTIN UNIVERSITY, AUSTRALIA

Reason for pursuing analytical science: To improve human health and tackle global problems arising from increasing food, environmental, and water insecurity. My interest in science started when I learned to interpret mass spectra and reconstruct chemical compounds in A-Level Chemistry – the tasks strangely felt like solving an intriguing puzzle rather than doing my classwork. Fast forward eleven years and MS, together with other computational and lab-based analytical chemistry, is still central to my research. What I find most satisfying is to use these high-resolution techniques to solve real-world problems, especially in the food, agriculture, health and forensics sector.

MICHAEL BREADMORE

DIRECTOR OF THE AUSTRALIAN CENTRE FOR RESEARCH ON SEPARATION SCIENCE, UNIVERSITY OF TASMANIA, AUSTRALIA

Reason for pursuing analytical science: I became an analytical scientist because I decided I didn't want to be a lawyer and I was a terrible synthetic chemist!
Future of the field: In 20 years' time, I think we'll see analytical chemistry everywhere… it will have made the transition from academia to everyday use within society.
Dinner party guest: My grandfathers – I never got to meet either of them.
Advice to younger self: Understand yourself.

PHILIP MARRIOTT

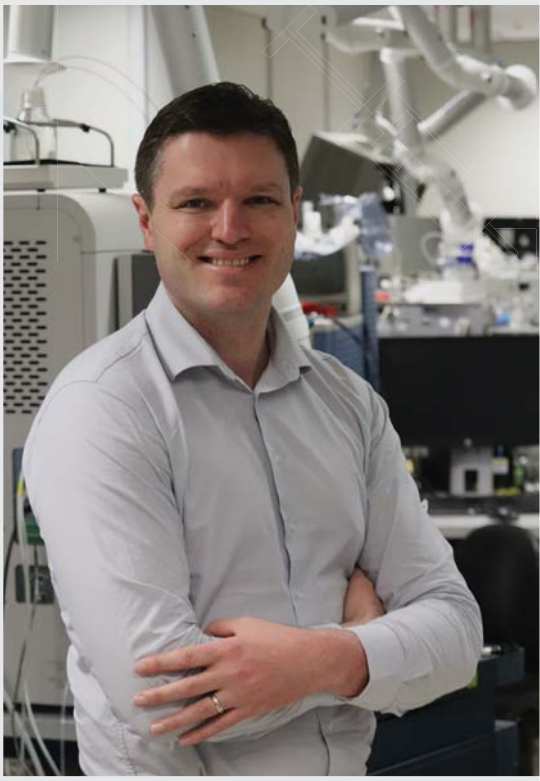
PROFESSOR, SCHOOL OF CHEMISTRY, MONASH UNIVERSITY, VICTORIA, AUSTRALIA

Greatest inspiration: Giddings' "Dynamics of Chromatography: Principles and Theory" was the first book I read during my PhD, introducing the science (and theory) of chromatography. The insight and innovation that Giddings has brought to the science of separations has always been inspiring; my own work over the last 20 years has relied heavily on his foundations in and understanding of multidimensionality and that's a wonderful way to close the loop.
Advice to younger self: The last 10-15 years have been very professionally rewarding, and we have also been blessed with three intelligent and successful children – there is little more I should want for. But, on reflection, I think a greater appreciation for the arts could serve me well… I would tell myself to follow my mother's wise counsel and continue with those piano lessons!

SIMON LEWIS

PROFESSOR OF FORENSIC AND ANALYTICAL CHEMISTRY, CURTIN UNIVERSITY, AUSTRALIA

Future of the field: The increasing use of advanced analytical instrumentation to probe the chemistry of latent fingermarks will lead to a better understanding, and enhanced recovery and use, of this important form of forensic evidence.
Dinner party guest: Though I hope that my research will have long-term impact, I suspect my lasting influence will be through my teaching and it would be wonderful to sit down and talk shop with my late grandfather who was a high school teacher for over 40 years.
Advice to younger self: Pay more attention in statistics classes at school! (It would have saved me some pain in later years.)



WILLIAM ALEXANDER DONALD

ASSOCIATE PROFESSOR AND AUSTRALIAN RESEARCH COUNCIL FUTURE FELLOW, SCHOOL OF CHEMISTRY, UNIVERSITY OF NEW SOUTH WALES, SYDNEY, AUSTRALIA

Greatest inspiration: I find Thomas Edison inspirational. The development of the practical light bulb required testing thousands of different materials for their potential use as filaments. As the story goes, Edison was asked by a reporter: "Mr Edison, how did it feel to fail 1,000 times?"His reply: "I did not fail 1,000 times. The light bulb was an invention with 1,000 steps."
Dinner party guest: Marcus Aurelius because I am interested in stoic philosophy and ancient Rome.
Time travel destination: I would go 100 years into the future. We are living in strange times. I'd like to see where we are headed.

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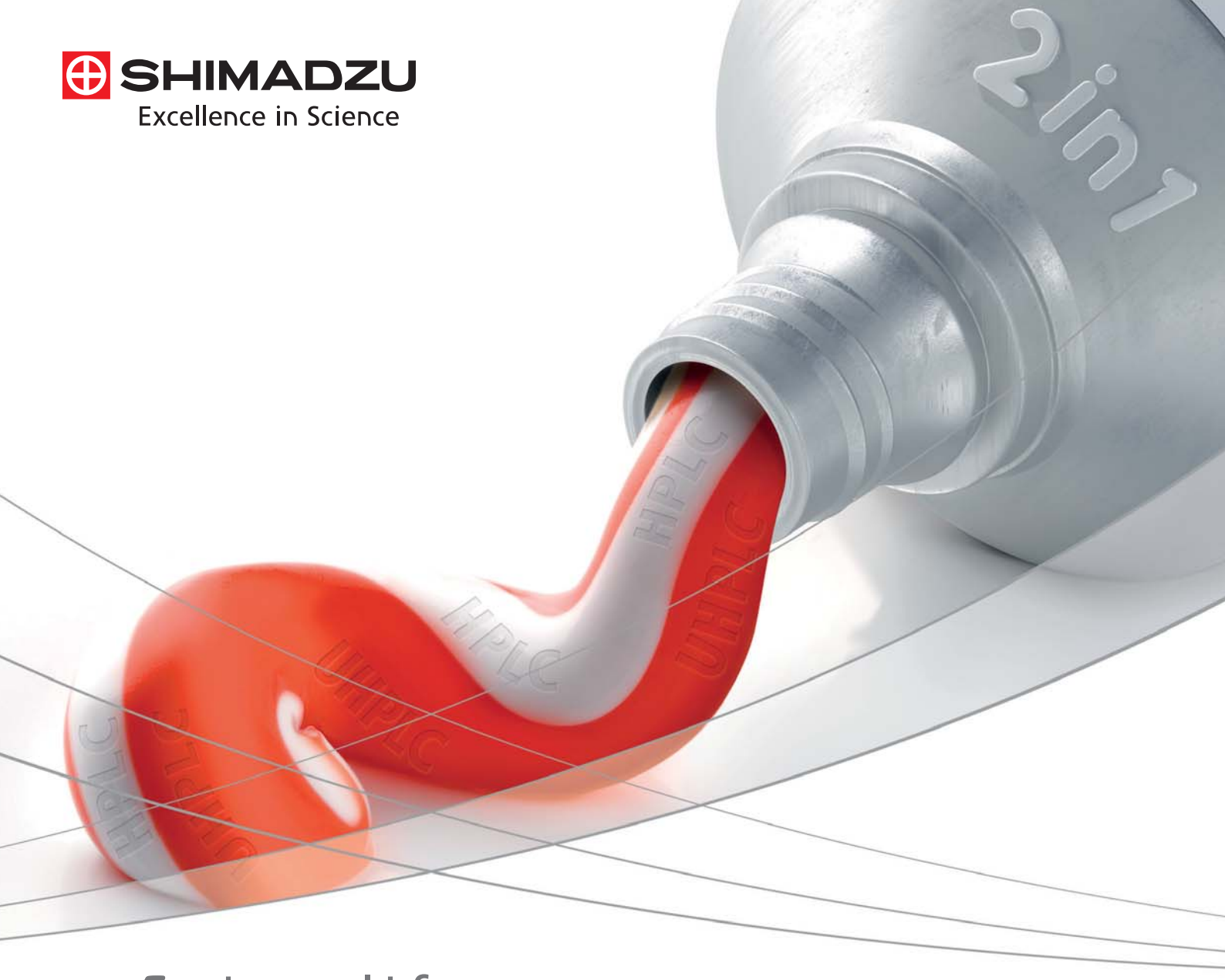

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EUROPE

ANDREW DEMELLO

PROFESSOR OF BIOCHEMICAL ENGINEERING, ETH ZÜRICH, SWITZERLAND

Greatest inspiration: That's easy – my family. My parents gave me the perfect start in life and gave me the confidence to aim high and not worry about making mistakes. My wife and children keep me sane and remind me how fun life can be.
Dinner party guest: This is a little left of field but I would love to have dinner with Sir Francis Walsingham. He was principal secretary to Queen Elizabeth I in the 16th Century and England's first "Spymaster General." He created the first sophisticated intelligence network and was central to thwarting foreign attacks (such as the Spanish Armada) and domestic plotters who sought to unseat the Queen. Politics aside, his tableside conversation would be fascinating!

CAROLINE WEST

PROFESSOR, INSTITUTE OF ORGANIC AND ANALYTICAL CHEMISTRY, UNIVERSITY OF ORLÉANS, FRANCE

Greatest inspiration: My mother. She is a role model both professionally and personally. We share the same love of learning new things and the desire to share that knowledge. I try to keep the same balance that she had of being deeply committed to her job, while always being present for her family.
Time travel destination: I would go back to the eighteenth century, when you could be both a writer, a scientist, a philosopher, and an artist – and when there was still so much to discover that you could be involved in several areas of science. Progress in science has made us all much more specialized – I don't like being stuck in one box, I like to explore different areas.
Advice to younger self: Firstly, to be more indulgent. But more importantly, to be more forgiving to small deficiencies – in things, in people, and especially in myself. Perfection is not in this world. Just do your best!

DAVY GUILLARME

SENIOR LECTURER AND RESEARCH ASSOCIATE, SCHOOL OF PHARMACEUTICAL SCIENCES, UNIVERSITY OF GENEVA, SWITZERLAND

Future of the field: Since the 1960s, the field of liquid chromatography has never stopped evolving, and I am convinced this will continue for the next 20 years. I see a lot of interest in miniaturization of LC and on-site analysis. And over the last few years, there has been a lot of work to improve analysis speed and resolution. The need for better sensitivity could be tackled in the coming years with a new detector (perhaps something other than MS) or a new way to perform chromatographic experiments. Interestingly, I also see more and more people who need to use LC, but have absolutely no knowledge on it – I think some easy-to-use or fully automated LC instruments will probably make an appearance.

DUNCAN GRAHAM

DISTINGUISHED PROFESSOR AND HEAD OF DEPARTMENT, PURE AND APPLIED CHEMISTRY, UNIVERSITY OF STRATHCLYDE, GLASGOW, UK

Future of the field: I wish I knew! The field has changed so much in the last 10 that to look 20 years forward is beyond my brain's capacity. But if I had to speculate, I'd think more real-time measurements in all manner of environments including in vivo combined with AI to produce data without the need for interpretation or decision making.
Dinner party guest: Ozzy Osbourne, he sang some amazing songs (I love heavy metal) and he raised some hell. Hearing his stories first hand would be the soft lad's way of living the metal dream.
Time travel destination: I'd love to go back to the early 1900s. Science and engineering were expanding exponentially and it would have been an amazing time to be around.
Advice to younger self: Don't be in a hurry to get to the endpoint and enjoy the journey!

IAN WILSON

PROFESSOR OF DRUG METABOLISM AND MOLECULAR TOXICOLOGY, IMPERIAL COLLEGE LONDON, UK

Greatest inspiration: There are many scientists that have inspired me over the course of my career – far too many to list – but the person who has undoubtedly had the most influence on my research is Jeremy Nicholson, with whom I have collaborated for nearly 40 years.
Future of the field: In 20 years' time? I think the field will be getting on fine without me…
Dinner party guest: Ernest Shackleton, a remarkable explorer who wrote, "I believe it is in our nature to reach out into the unknown," which applies just as well to research. The impressive thing about him was that, unlike many explorers of the day, he knew when to turn back. He might have been the first to stand at the South Pole; he and his two companions got close enough to know they could complete the journey. But he also knew they would die on the way back, so he turned them around and they all survived. All his trips were ill-fated but, as a result of good management, great courage, and true leadership, he never lost a man. Who would you want to have as your manager – a hero who kills everyone trying, or someone who can balance risk?

KAREN FAULDS

PROFESSOR, HEAD OF BIONANOTECHNOLOGY AND ANALYTICAL CHEMISTRY, UNIVERSITY OF STRATHCLYDE, GLASGOW, UK

Reason for pursuing analytical science: I think I was destined to be a scientist from a young age. I was one of those (very) annoying (to their parents) children who constantly asked "Why?" and carried out experiments and made terrible concoctions, usually involving my Mum's perfume and flower petals! I enjoyed all the sciences at school, but my true passion was always chemistry. I need to carry out work that has a purpose – where my research could have an impact on peoples' lives or environments – and analytical chemistry was always the natural pathway for me.
Greatest inspiration: I am most inspired by the early-career researchers I have the privilege of working with every day. Research can be challenging, frustrating, and disheartening, and on top of that there are personal issues to deal with – but it is also highly rewarding and offers many experiences and opportunities. It is always inspiring to watch researchers grow in their capabilities and confidence as they overcome challenges.
Advice to younger self: Take advantage of all the opportunities that come your way, even if they challenge and scare you at first!

LUIGI MONDELLO

FULL PROFESSOR OF ANALYTICAL CHEMISTRY, UNIVERSITY OF MESSINA, ITALY

Dinner party guest: Without a doubt, Marcel Golay (1902-1989) would be the first name on my list. Anyone who works in the field of chromatographic techniques knows Golay for his pioneering work in the field of GC.
Time travel destination: That's difficult! I think I would travel to the future, not a precise day, but somewhere in the next two or three decades. I'd be curious to see the impact I would have made, if any – and not purely from a scientific standpoint. Of course I would like to know where separation science is headed, but the biggest reward would be knowing whether the people I have trained will benefit from my teachings. As the coordinator of a research group, I am challenged every day to find the unique attributes and talents of each individual in my team, and to capitalize on these.

MICHAL HOLČAPEK

PROFESSOR, DEPARTMENT OF ANALYTICAL CHEMISTRY, FACULTY OF CHEMICAL TECHNOLOGY, UNIVERSITY OF PARDUBICE, CZECH REPUBLIC

Reason for pursuing analytical science: Analyzing the quality and quantity of unknown samples was always something that fascinated me. But an important factor in my pursuit of analytical science was also the enthusiasm of my teachers at the University of Pardubice at the time – some of them world leading scientists, others skillful practitioners in laboratory courses, and all of them stimulated by interest. I try to motivate my students and postdocs to have the same fascination in analytical chemistry now.
Future of the field: In lipidomic analysis, I think we'll see routine quantitation of numerous lipids and metabolites in a highly automated fashion, as well as their correlation with metabolic pathways. Unlike now, individual lipid species will be taken into account, not just lipid classes. Having a comprehensive quantitative metabolomic profile will take us one step closer to truly personalized medicine – nowadays this is just a dream, but I hope that it will be common practice in 20 years' time.
Advice to younger self: My advice to my younger self (and others as well) would be to enjoy both scientific and personal life as much as you can, because time is passing so quickly. I have, and I have no regrets – except perhaps that my duties mean I can't practice sport as much as I could 20 years ago… understandable, but not easy to accept as a competitive character!

PHILIPPE SCHMITT-KOPPLIN

DIRECTOR OF THE RESEARCH UNIT ANALYTICAL BIOGEOCHEMISTRY AT HELMHOLTZ ZENTREUM MUENCHEN, GERMANY, AND DIRECTOR OF THE FOODOMICS PLATFORM AT THE INSTITUTE OF ANALYTICAL FOOD CHEMISTRY, TECHNICAL UNIVERSITY OF MUNICH, GERMANY

Reason for pursuing analytical science: Louis Pasteur. He was a scientific inspiration to me for his humanistic and integrative curiosity in the fields of microbiology and health, fermentation, molecular asymmetry, the emergence of life using up-to-date analytical sciences, and (still very relevant in 2020) his pioneering work with infectious diseases.
Future of the field: A multidimensional, big-data world in the highest chemical resolution mined with the help of AI – but still reliant on human brains…
Nominator comment: For his outstanding achievements in the description of complexity, and complex chemistry, in systems subjected to biotic and abiotic transformations.

ROY GOODACRE

PROFESSOR OF BIOLOGICAL CHEMISTRY, DEPARTMENT OF BIOCHEMISTRY, UNIVERSITY OF LIVERPOOL, UK

Dinner party guest: Harry Harrison. He was an American science fiction writer and my favorite author. I'd love to discuss with him how he came up with the Stainless Steel Rat series, which was packed full of action and humor, as well as being highly satirical. The year before I was born, he wrote 'Make Room! Make Room!' It's a brilliant book about overpopulation and consumption of Earth's resources – and it would be fascinating to know where his prophetic ideas came from.
Time travel destination: Robert Koch was the father of modern bacteriology; Koch's postulates were initially formulated in 1884. These established the relationship between a specific microbe causing a specific disease. I was trained as a microbiologist and use Raman and IR spectroscopy as well as MS to characterize bacteria that cause disease. It would have been brilliant to observe Koch's eureka moment – one that has served microbiology so well for so long.
Advice to younger self: Try to smile a bit when you're recording those online teaching lectures and research seminars… You look too serious!

NORTH AMERICA

JAMES JORGENSON

KENAN DISTINGUISHED PROFESSOR OF CHEMISTRY, EMERITUS, DEPARTMENT OF CHEMISTRY, UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL, USA (RETIRED)

Reason for pursuing analytical science: I started college with the intention of being a biologist and then a biochemist. But exposure to the capabilities and possibilities of instrumentation for chemical analysis grabbed my imagination. It has been a stimulating and rewarding pursuit.
Greatest inspiration: Michael Faraday. He was self-educated and yet a pivotal figure in the development of both physics and chemistry.
Advice to younger self: Be more patient!

JENNIFER VAN EYK

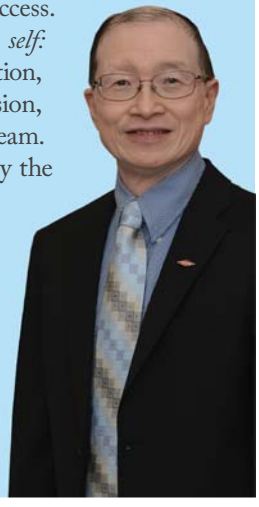
PROFESSOR OF CARDIOLOGY AND PATHOLOGY, ERIKA GLAZER ENDOWED CHAIR IN WOMEN'S HEART HEALTH, AND DIRECTOR OF THE ADVANCED CLINICAL BIOSYSTEMS RESEARCH INSTITUTE AT CEDARS-SINAI MEDICAL CENTER, LOS ANGELES, CA, USA

Future of the field: The adoption of telehealth with the use of self-administered blood sampling devices (imagine clinical samples collected by anyone, anywhere, and anytime) will increase, as will quantitative proteomic technologies for the continuous assessment of health status. I anticipate an overall movement towards equity in health assessment.
Advice to younger self: To rejoice in both the small and large successes of yourself and those around you. As an example, we had a gong – and later a ship bell – in our lab, which we rang to celebrate events like a troublesome experiment working or a paper being accepted.

JIM LUONG

FELLOW, ANALYTICAL SCIENCE, CORE R&D, DOW CHEMICAL, MI, USA

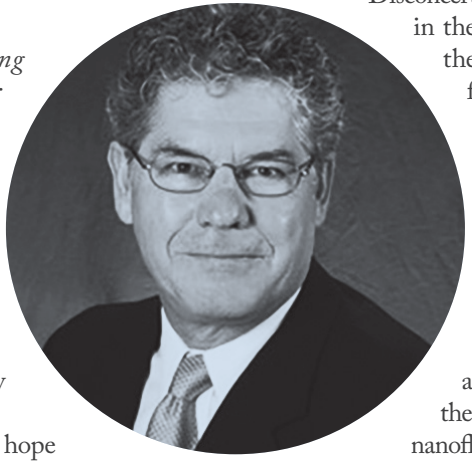
Reason for pursuing analytical science: Analytical chemistry is the foundation for many disciplines' successes, from drug discoveries to the commercialization of consumer products. I am passionate about problem solving and have a strong desire to make a positive impact, particularly in separation sciences. A career in this field is highly rewarding, as new challenges continue to emerge.
Future of the field: Despite being considered a well-established technology with its invention dating back over half a century ago, GC's popularity and impact are not only healthy but increasing! There are continuous innovations in hardware and applications. Hyphenated techniques, along with advances in digital transformation, AI, electronics, material science, 3D-printing manufacturing, and improved surface deactivation chemistries, will assert the technique's value in enabling future success.
Advice to younger self: Find your motivation, nurture your passion, and follow your dream. Take time to enjoy the journey, and learn from and share with others your experience. Modern science is a team sport.



MICHAEL RAMSEY

PROFESSOR OF BIOMEDICAL ENGINEERING, PROFESSOR OF APPLIED PHYSICAL SCIENCES AND MINNIE N. GOLDBY DISTINGUISHED PROFESSOR OF CHEMISTRY, THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL, USA

Reason for pursuing analytical science: While as an undergraduate student I enjoyed chemistry, but once I took instrumental analysis as a senior, I found that I was intrigued by instrumentation.
Future of the field: I hope we are somewhere beyond my wildest imagination!
Dinner party guest: Richard Feynman. His biographies show that he was obviously very clever and probably someone who was a lot of fun to be around.
Misconceptions of science in North America: Disconcertingly, current events in the USA suggest that there is a significant fraction of our population who do not believe in science or understand its teachings!
Nominator comment: His initial work on micro-total analysis systems set the stage for micro- and nanofluidic technologies.



JOSEPH LOO

PROFESSOR, DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY, UNIVERSITY OF CALIFORNIA-LOS ANGELES, USA

Reason for pursuing analytical science: I was always (and still am) a huge fan of Star Trek's Spock. I loved his analytical thinking, and the concept of his tricorder captured my imagination. I later became a fan of a TV show called Quincy, M.E. that depicted the lives of criminalists, lab techs and medical examiners to solve crimes. Using analytical science to solve puzzles fascinated me then and still does today.
Dinner party guest: I'd love to have a long dinner with chefs Julia Child and Jacques Pépin. The food and wine would be spectacular, and talking about their careers would be equally engaging.
Advice to younger self: Nothing in this life is totally predictable. People will give you all kinds of advice. Be true to your gut instincts and your interests. It will work out, and life will be fun!

RAOUL KOPELMAN

RICHARD SMALLEY DISTINGUISHED UNIVERSITY PROFESSOR OF CHEMISTRY, PHYSICS, APPLIED PHYSICS, BIOPHYSICS, BIOMEDICAL ENGINEERING AND CHEMICAL BIOLOGY, AND MEMBER OF THE MICHIGAN NANOTECHNOLOGY INSTITUTE FOR MEDICINE AND BIOLOGICAL SCIENCES, THE MICHIGAN BIOINTERFACES INSTITUTE, THE ROGEL CANCER CENTER, UNIVERSITY OF MICHIGAN HOSPITAL, USA

Time travel destination: The moment after the apple fell on Newton's head. Because of a pandemic then, Newton avoided Cambridge and London, and escaped to a far-away (in terms of the time) farm. And that's why he was under an apple tree before making a discovery that would define modern science.

Advice to younger self: To be a successful scientist and teacher you have to understand human nature and jealousies. In my first year as an instructor, I introduced the use of computers to my senior students. The Dean, also a chemist, intervened and forbade me from doing the same the next semester, calling the use of computers "anti-educational." One of these students eventually won the Nobel Prize for "Computational Chemistry."

Nominator comment: I'm nominating Raoul because of his development of novel sensing/imaging technologies that use photoacoustics and photoacoustic lifetime-based measurements.

ROBERT KENNEDY

HOBART WILLARD DISTINGUISHED PROFESSOR OF CHEMISTRY AND CHAIR OF THE CHEMISTRY DEPARTMENT, UNIVERSITY OF MICHIGAN, USA

Reason for pursuing analytical science: I have been fascinated by how we "know" things; measurements are key to that. Furthermore, I like instruments and machines that are complex and precise. As a practicing analytical scientist, it's exciting to be able to participate in so many different fields.

Misconceptions of science in North America: I see two big misconceptions in the US regarding science. Some people seem to think that science will solve all problems. Another misconception (that seems to be growing) is that science is partisan or not to be trusted, or that pseudo-science is just as good as real science. This is frustrating in arguments over climate change, where a small number of contrarians get equal attention to the huge number of serious and rigorous studies. We also have an anti-vaccine movement that is about to collide with our best chance of getting the pandemic under control.

RICHARD VAN BREEMEN

PROFESSOR OF PHARMACEUTICAL SCIENCES, LINUS PAULING INSTITUTE AND COLLEGE OF PHARMACY, OREGON STATE UNIVERSITY, USA

Reason for pursuing analytical science: My father Verne van Breemen (named after Jules Verne) and my maternal grandfather Harry M. Hines were both professors and biomedical researchers. As a preschooler, my father would bring me to his electron microscopy laboratory, where he was pioneering the use of transmission EM to visualize intracellular organelles in the 1950s and 1960s. The walls of his laboratory were covered with electron micrographs and the transmission electron microscopes were awesome.

Dinner party guest: Linus Pauling. I had a chance to meet Linus Pauling following a lecture he gave in 1987, but I had no idea that one day my laboratory would be based at Oregon State University at the research institute he had founded. During our brief meeting, we discussed how to approach teaching undergraduate students spectroscopic techniques, especially MS. Given the opportunity to talk with Linus Pauling over dinner, I would love to discuss my interest in using MS for natural product drug discovery in the context of our mutual goals of preventing diseases of aging.

YING GE

PROFESSOR, UNIVERSITY OF WISCONSIN-MADISON, USA

Reason for pursuing analytical science: : Analytical scientists can develop creative technologies to uncover the fascinating insights in biology, understand the underlying mechanisms of diseases, and invent new diagnostic assays. We can help bridge the silos in chemistry, biology, and medicine, and play critical roles in both academia and industry.
Dinner party guest: Marie Curie, a two-time Nobel Prize laureate and a mother of two daughters (one of whom, Irène Joliot-Curie, also won a Nobel Prize). She is a role model for women scientists, especially those of us who are trying to balance family life with scientific careers.
Nominator comment: Ying Ge is leading top-down proteomics into the realm of clinical diagnostics through innovations in sample preparation, intact protein separations, and top-down characterization of proteins in cardiac disease. Her excellence has been recognized in multiple areas of analytical chemistry; she received the Georges Guiochon Faculty Fellowship in 2016 and the Biemann Medal in 2020. Among her achievements are the development of an MS-compatible photocleavable surfactant to facilitate membrane protein analysis by MS and advances in monoclonal antibody and antibody-drug conjugate analysis techniques. It's hard to believe that she is only in her seventh year as a principal investigator!

ROHIT BHARGAVA

FOUNDER PROFESSOR OF ENGINEERING AND CHEMISTRY AND DIRECTOR OF THE CANCER CENTER, UNIVERSITY OF ILLINOIS, USA

Reason for pursuing analytical science: As a starting graduate student, I became aware of attempts to combine conventional optical spectroscopy with imaging and was immediately hooked. It seemed, as it does to this day, that we would be able to "see" molecules that comprise all natural and human-made materials around us. To me, this molecular distribution seemed to hold the key to understanding systems. The techniques that are now called chemical imaging seemed to be an excellent way to observe this without the perturbation of labels or probes.
Future of the field: The very rapid development of analytical instruments, discovery of new capabilities through theoretical modeling and increased use of computing is going to revolutionize the field. In particular, I would expect many different forms of measuring infrared imaging data in inanimate and living systems.

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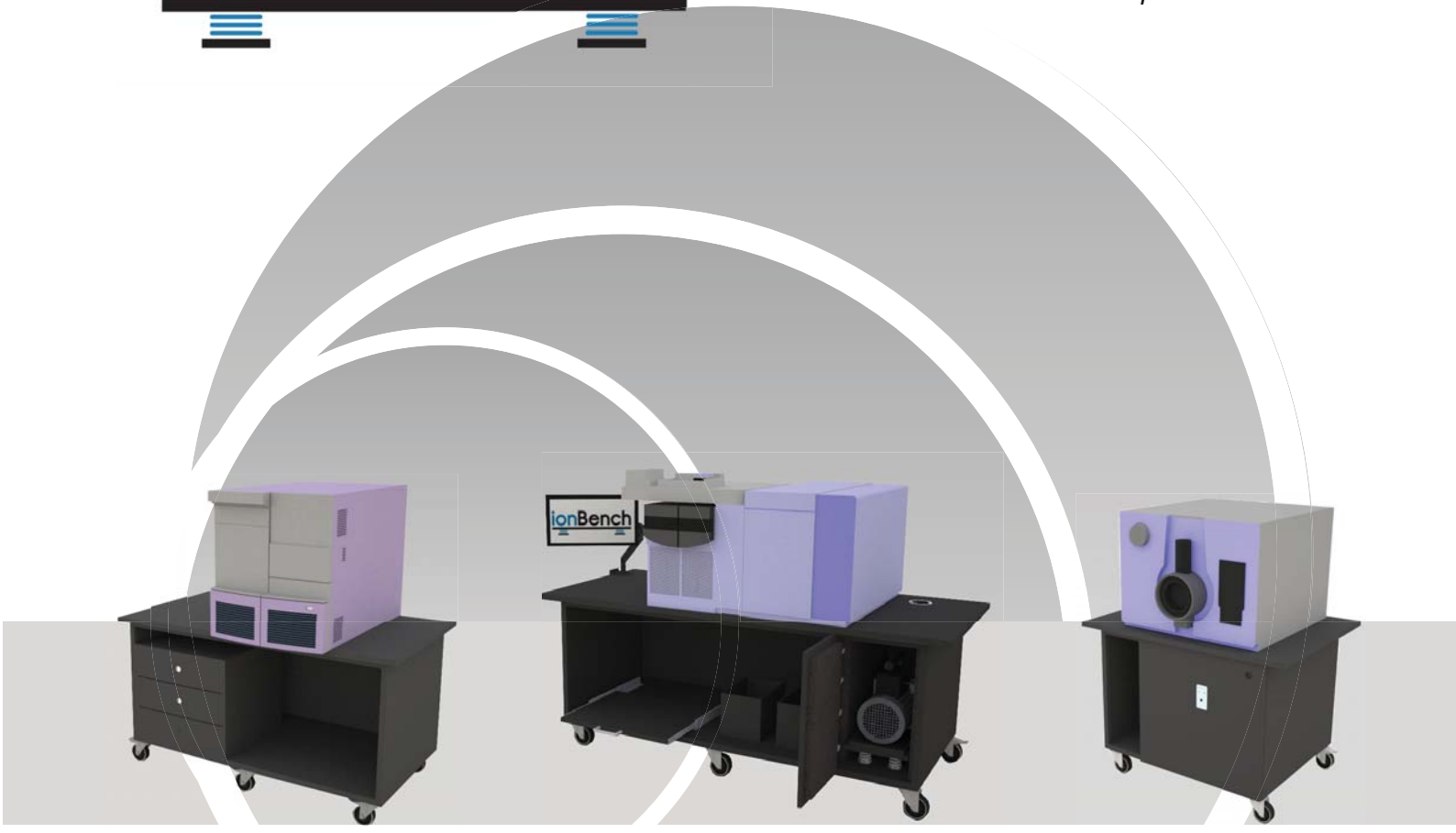

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SOUTH AMERICA

CLAUDIA ZINI

FULL PROFESSOR, THE CHEMISTRY INSTITUTE, FEDERAL UNIVERSITY OF RIO GRANDE DO SUL, BRAZIL

Reason for pursuing analytical science: The simultaneous presence of incredible beauty, art, mystery, complexity, and simplicity in nature was my main motivation to become an analytical scientist. I was also drawn to this field by an early understanding that analytical chemistry contributes so much to many different fields. Because of this, it also provides a larger opportunity for productive interactions with colleagues from different countries in distinct areas and segments of society.
Greatest inspiration: Everything! From a "simple" glass containing milliliters of water to a sample of wine that renders a very rich GC×GC chromatogram of volatile compounds, everything is enchanting.

FABIÁN PARADA

ASSOCIATE PROFESSOR, HIGH PRESSURE LABORATORY, FOOD CHEMISTRY RESEARCH GROUP, DEPARTMENT OF CHEMISTRY, FACULTY OF SCIENCE, NATIONAL UNIVERSITY OF COLOMBIA

About: As coordinator of the Pressurized Fluids Laboratory at the National University of Colombia, Fabián Parada Alfonso has made a significant research contribution to the knowledge around extraction techniques in green chemistry. The purpose of this work is to obtain extracts from different plant sources for applications across a broad range of fields, including the food, pharmaceutical and cosmetic industries. He is also involved in the training of undergraduate and graduate students in chemistry, chemical engineering, agriculturalengineering and mechanical engineering.
Nominator comment: For his advances in supercritical fluid extraction as a preparative tool for valorizing agricultural wastes and his efforts to achieve a zero-waste scenario in a circular economy.

ELENA STASHENKO

DIRECTOR, RESEARCH CENTER FOR BIOMOLECULES (CIBIMOL), RESEARCH CENTER OF EXCELLENCE (CENIVAM), UNIVERSIDAD INDUSTRIAL DE SANTANDER BUCARAMANGA, COLOMBIA

Time travel destination: I would have liked to visit Constantinople at the beginning of the 15th century, or the Republic of Venice in the times of Titian, Tintoretto, and Veronese. They were centers of culture, history, beauty, elegant traditions, and brilliant (but sometimes unusual) ideas.
Misconceptions of science in South America: Often people don't understand what science is for or why we should invest in it. For this reason it is crucial that scientific ideas are communicated to the public.

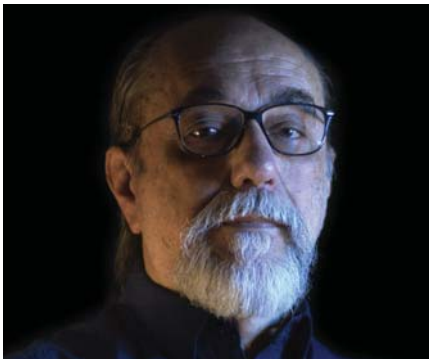
ELINA BASTOS CARAMÃO

PROFESSOR AND RESEARCHER, INSTITUTE OF TECHNOLOGY AND RESEARCH, TIRADENTES UNIVERSITY, SERGIPE, BRAZIL

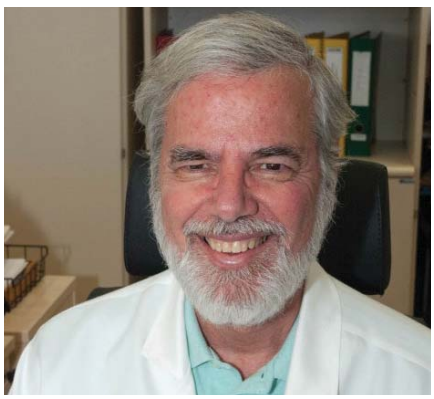
About: Elina Bastos Caramao has over 35 years of experience in analytical chemistry, with a particular focus on chromatography, GCxGC, MS, (bio)fuels, biomass, and natural products. After retiring from the Federal University of Rio Grande do Sul, she has been teaching a postgraduate program in industrial biotechnology at Tiradentes University. She has over 2,200 citations to her name, with 146 published works in total.
Nominator comment: She has contributed significantly to the development of chromatographic methods, and is currently developing 2D-GC methods for characterization of fuels, including biofuels.

FERNANDO M LANCAS

PROFESSOR OF CHEMISTRY, INSTITUTE OF CHEMISTRY AT SÃO CARLOS, UNIVERSITY OF SÃO PAULO, BRAZIL



Dinner party guest: I would like to have dinner with my parents. In this (more mature) stage of my life, I would like to thank them for showing me the correct path and always investing in my future. Without their direction and tremendous efforts, I am not sure that I would have the same ideas I have now about people, life, and the future on Earth.
Time travel destination: I would love to travel to ancient Egypt to learn more about their practice of medicine. I am sure that we lost incredible amounts of information about this over time, and recovering it could be an essential resource for our future.
Advice to younger self: Be persistent. Science, either in the academic or industrial world, is not as easy or glamorous as it first looks. In particular for those young people interested in pursuing an academic career in science: many nights, weekends, and holidays will be dedicated to proofreading papers, preparing proposals, reviewing papers for scientific journals, traveling to attend meetings… If you enjoy it, you are in the right place. If not, for the sake of your own happiness, you should make a change as soon as possible. In the end, this is the most critical lesson in life.



FRANCISCO RADLER DE AQUINO NETO

HEAD OF THE BRAZILIAN DOPING CONTROL LABORATORY, COORDINATOR OF THE LABORATORY FOR THE SUPPORT OF TECHNOLOGICAL DEVELOPMENT, AND EMERITUS PROFESSOR, ORGANIC CHEMISTRY DEPARTMENT, INSTITUTE OF CHEMISTRY, FEDERAL UNIVERSITY OF RIO DE JANEIRO (UFRJ), BRAZIL

About: Francisco Radler de Aquino Neto finished his doctorate in organic chemistry at UFRJ in 1978, going on to complete postdoctoral internships at both the Louis Pasteur University in Strasbourg, France, and the University of Cambridge, UK. He has received many accolades and awards throughout his expansive career, with his research covering many different fields – from drug doping and indoor air quality control, to molecular organic geochemistry and the characterization of emissions, waste and effluents.
Nominator comment: Francisco Radler is one of the most influential researchers in analytical chemistry in Brazil. He has a long and solid career exploring useful applications of chromatography and MS, ranging from geochemistry to sports doping control. He is the man responsible for the Brazilian Doping Control Laboratory, which is undoubtedly a great source of pride for the region, having been able to operate for more than 30 years with extremely high standards.

JORGE C MASINI

ASSOCIATE PROFESSOR, INSTITUTE OF CHEMISTRY, UNIVERSITY OF SÃO PAULO, BRAZIL

Reason for pursuing analytical science: The interdisciplinarity of analytical chemistry. From helping to elucidate the composition of matter from trace to major constituents, to the quality control of everyday products, to rocks on the Moon.
Future of the field: I think we will see more and more portable instrumentation, including chromatographs and their detectors being used in automated real-time, in situ monitoring systems, exploring the connectivity of the internet.
Misconceptions of science in South America: Science is mostly thought of as an elite expense and not as an investment.
Advice to younger self: Keep your focus on the research that motivates you most, independent of things such as H-index.

MAÍRA FASCIOTTI

RESEARCHER, ORGANIC ANALYSIS LABORATORY, THE NATIONAL INSTITUTE OF METROLOGY, QUALITY AND TECHNOLOGY (INMETRO), BRAZIL

Dinner party guest: It would be a toss-up between Nobel nominee Otto Gottlieb, the greatest in the field of natural products, and Maynard James Keenan, the frontman of my favorite band "Tool." I would want to hear how Gottlieb was able to make such advancements in natural product structural elucidation at a time when many of our advanced techniques were not available. And music and art have been such a huge inspiration to me throughout my career that I'd want to thank Keenan for helping me get through not only my education, but my day-to-day life!
Misconceptions of science in South America: While not a total misconception, I think many scientists believe that we do not have the access to materials and instrumentation, or the capability, to do state-of-art science in Brazil. We do. We have wonderful laboratories and brilliant and motivated minds. Brazilians are creative; we always find a way to solve an issue. In science, this is very important. Of course, we are facing economic and other challenges that impact our ability to get science done, but even in these difficult moments, we don't give up and we do our best.

NORBERTO PEPORINE LOPES

PROFESSOR, RESEARCH CENTER FOR NATURAL AND SYNTHETIC PRODUCTS, FACULTY OF PHARMACEUTICAL SCIENCES OF RIBEIRÃO PRETO, UNIVERSITY OF SÃO PAULO, BRAZIL

Reason for pursuing analytical science: Since I was a child I have been interested in issues related to nature. I grew up following the phytochemical work done by my father and uncle – a natural step to understand secondary metabolism and its ecological functions would be to devote myself to analytical chemistry.
Greatest inspiration: My father! From very adverse social conditions, he reached high places in his university career. He taught me to always keep a smile on my face and work hard – that is, to enjoy what you do. That way, you can achieve any of your dreams.
Time travel destination: I would like to have joined Darwin for his expedition to the Galápagos. I am fascinated by the evolutionary observations made on such a small piece of land.
Advice to younger self: Speed up a little more! Make time for those expeditions and expand your learning.
Nominator comment: He's made a huge contribution to the MS field in Brazil, and in the world.

MARCOS NOGUEIRA EBERLIN

MACKMASS LABORATORY, SCHOOL OF ENGINEERING, MACKENZIE PRESBYTERIAN UNIVERSITY, SÃO PAULO, BRAZIL

Future of the field: Compact, robust and easy-to-operate mass spectrometers will be everywhere, constituting major analytical tools in hospitals, clinics, and doctors' offices, as well as being central to the monitoring of air and water quality, drug screening, airport security, adulteration in food, pharmaceuticals and cosmetic products.
Dinner party guest: I would select J. J. Thomson, the father of MS, the man who discovered the electron, and the 1906 Nobel prize winner in physics. I myself have won the Thomson medal and I'd love to tell him how I was inspired by his work.

Superior Size Separation

KNAUER AZURA GPC/SEC systems are designed to optimize both the user experience – and the end results.

Characterizing polymers and biomolecules is essential to many areas of research – from understanding new materials to fighting pandemics. The separation technique of choice? Depending on your application (or your background), you may call it gel permeation chromatography (GPC), size-exclusion chromatography (SEC) or gel-filtration chromatography (GFC). We spoke to Hanna-Maija Hiltunen to hear how KNAUER's AZURA GPC/SEC systems allow chromatographers to wield size-based separation techniques with the utmost precision.

For the uninitiated, what is SEC and how is it typically applied?

In short, SEC separates analytes by size using special columns with a porous matrix. The basic separation principle relies on the fact that smaller molecules will be more likely to enter those pores, making their travel through the matrix longer than that of larger molecules. Separations (typically of a mixture of polymers, polysaccharides or biomolecules) are facilitated by choosing optimal particle and pore sizes, as well as column length. SEC is often used in quality control and R&D.

What are KNAUER's key GPC/SEC offerings?

Our AZURA GPC/SEC systems are the newest addition to our chromatography portfolio. AZURA GPC/SEC systems incorporate the well-established KNAUER pump and detector technology from our analytical HPLC systems but optimized and configured to meet the requirements of GPC/SEC applications.

Can you explain your definition of GPC/SEC?

That's a good question! We are trying to be as inclusive as we can within the constraints of confusing terminology. GPC, GFC and SEC all essentially describe the same methodology, but the term GPC tends to be used in polymer chemistry by those working with aggressive, organic solvents, while SEC and GFC are more commonly used by those separating biomolecules using aqueous solvents (buffers) or to reflect the use of aqueous buffers in polymer separations. Whether working with organic solvent- or aqueous-based systems, there are some inherent system challenges. The solvents used in polymer analysis are chosen for their ability to dissolve polymeric substances – and therefore may damage certain components of a device. And the use of salt buffers in SEC is harmful to metal components of the system. Hence, all liquid-contacting system components, from the valves and seals to tubing, must be carefully considered when developing such systems.

What other challenges does GPC/SEC pose for chromatographic systems – and how does AZURA fit the bill?

In addition to the aforementioned system material requirements, GPC/SEC analyses necessitate lower flow rates and lower pressure than HPLC. GPC/SEC runs are conducted isocratically, so a good isocratic pump is essential for a steady baseline – and the AZURA's excellent isocratic pump has been specifically optimized to meet the requirements of GPC applications.

We've also put a great deal of thought into optimizing the AZURA RI detector, with a focus on increasing the detector performance using organic solvents. However, our GPC/SEC systems can also be configured to use a UV/Vis detector – there is the choice between variable single wavelength detectors, multi-wavelength detectors and diode array detectors.

AZURA also affords customers the flexibility to extend their GPC/SEC systems with autosamplers, valves, feed pumps, and column thermostats. In fact, many GPC runs are conducted at higher temperatures (~60°C), so the AZURA column thermostat is of great interest.

Can you tell us more about the columns used in GPC/SEC?

The stationary phase in GPC/SEC applications is crucial. GPC/SEC separation efficiency is driven by long columns with large diameters, and the matrix is often based on porous silica or polymer material – the pore size determines the molecular weight range of the separation, and columns with different pore sizes are combined to broaden the separation range and increase resolution.

We've developed a great partnership with a local GPC/SEC column manufacturer called AppliChrom by combining our AZURA GPC/SEC portfolio with AppliChrom columns. This is a great way to bring our tremendous expertise in these areas together for the ultimate customer experience.

KNAUER

www.knauer.net/GPC

The Promise of eMetabolomics

Understanding specific interactions within and between organisms and their environment feeds into a much bigger endeavor: protecting the planet

By André van Roon and Peter W. Lindenburg, Research Group Metabolomics, Leiden Centre for Applied Bioscience, Faculty of Science & Technology, University of Applied Sciences Leiden, The Netherlands

"For the first time in history, the stability of nature can no longer be taken for granted […] Never has it been more important to understand how the natural world works and how to help it."

The opening lines of the critically acclaimed Netflix series "Our Planet," narrated by the famous British natural historian Sir David Attenborough, should really make us all stop and think. To play our part, we believe we can contribute to a better understanding of nature with environmental metabolomics.

For the uninitiated, metabolomics is the scientific study of the metabolome – the sum of all small-molecule intermediates and end-products of metabolism found in a given biological sample. Crucially, the composition of the metabolome is not only dependent on the biological system's current state but is also affected by many exogenous factors, including chemicals – medicines, food components, contaminants, and so on (1, 2).

Intelligent study designs, alongside modern analytical chemistry and sophisticated data analysis, enable us to extract valuable information from the metabolome – a point proven by the application of metabolomics to the area of human health and its significant contribution to the development of personalized medicine (3). It is now beyond any doubt that metabolomics adds an important layer of information to genomic and proteomic analyses.

At the Research Group Metabolomics of the Leiden Centre for Applied Bioscience, our ambition is to apply metabolomics in the fields of ecology, biodiversity, and environmental science. When metabolomics is applied to environmental questions – in other words, used to study the interaction between organisms and external stressors – it is fittingly called environmental metabolomics, or eMetabolomics for short (4). We broaden this definition and include interactions within and between species and their environment, with a view to addressing ecological and biodiversity issues.

The field of eMetabolomics offers promise for the following reasons:

- Changes in the metabolome are likely to be a more sensitive indicator of external stressors than information at the gene and protein levels (4).
- eMetabolomics is sensitive to the environmental effects of (emerging) chemical pollutants, including those not yet routinely monitored and/or with unknown modes of action. eMetabolomics may offer the first mechanistic insights into unknown modes of action.
- eMetabolomics can be used to study specific processes between organisms.
- And eMetabolomics can aid in the rapid identification of organisms.

Community service

To stretch the promise of eMetabolomics even further, we focus on the "community metabolome" – the collection of metabolites that are secreted into their environment by all the organisms within a given ecosystem. In essence, the community metabolome reflects the entire influence of various factors (climate, pollution, and invasive species) on the ecosystem in which we live (see Figure 1).

Currently, we are investigating the strength of eMetabolomics at the community level in a multi-omics

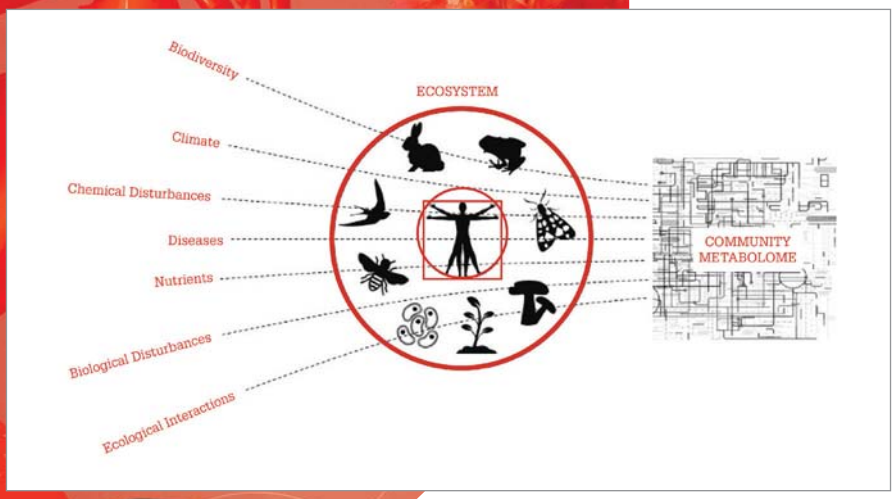


Figure 1. The community metabolome expresses, among other things, biodiversity, climate, chemical disturbances, diseases, nutrients, biological disturbances and ecological interactions.

investigation into ecological water quality. Acknowledging the importance of information layers, we also measure the unique traces of DNA generated by each organism in the aquatic ecosystem – dubbed environmental DNA or eDNA – as part of the project. Combining these two layers of information creates a multi-omics image (see Figure 2). The eDNA analysis provides us with information on which species are present in an aquatic ecosystem, while eMetabolomics provides us with information on which processes are taking place. For example, with the help of eDNA, we can detect the presence of water fleas; with eMetabolomics, we can demonstrate that the water fleas reproduce.

Cliff jumping

When an ecosystem is affected by a chemical (or any other) stressor, it may deteriorate only slowly – almost imperceptibly – at first. But it is known (5) that the slow and steady decline is very often followed by a period of much more rapid deterioration (like walking down a gentle grassy slope towards a cliff). Once the ecosystem has deteriorated too far – or dropped off the edge of the cliff – it takes a considerable amount of effort to restore its healthy state.

Clearly, a measuring system that can detect disturbances in an aquatic ecosystem at these earlier (and slower) stages of deterioration would be highly valuable – a warning shot. In alignment with metabolomics applied to human health issues, we believe that eMetabolomics is capable of detecting changes in the community metabolome earlier than classical methods used to measure ecological water quality (which is to say, the actual identification and counting of species). To return to the example of the water fleas, prior to dying and disappearing, water fleas first become ill – and that results in a change to their metabolome.

The Living Lab

Our current eMetabolomics project aims to understand the effects of both biological and chemical disturbances on an aquatic ecosystem located in the so-called Living Lab of Leiden University. To increase our chances of success, we have built an exciting multidisciplinary research consortium, involving biologists from the Dutch National Biodiversity Center Naturalis and environmental scientists from the Institute for Environmental Sciences of Leiden University. We've also recruited the assistance of several ecological consultancy companies and

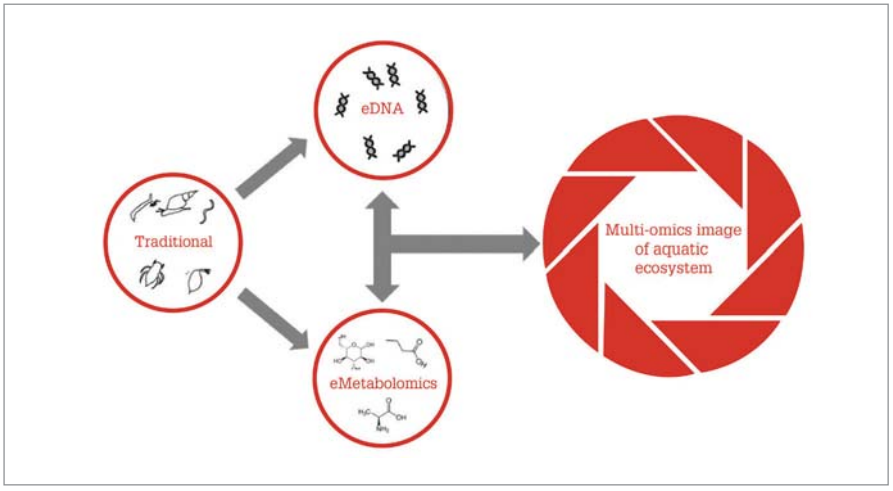


Figure 2. A molecular image combines information collected from the measurement of DNA (eDNA) and metabolic products (eMetabolomics)

governmental organizations.

The Living Lab consists of a testing field with 36 ditches. Some of these ditches have been disturbed by adding red swamp crayfish (*Procambarus clarkii*) or the pesticide thiacloprid. The red swamp crayfish is an invasive exotic species that is currently common in many locations, including the western part of The Netherlands, and it is feared to have a negative effect on aquatic biodiversity. Thiacloprid is a neonicotinoid pesticide, which has been shown to have a very negative effect on the insect population and insect-eating birds (6).

Over the course of several months, all of the ditches have been monitored manually, and samples have been collected for eDNA and community-metabolome analyses. First, we will pinpoint metabolites that are linked to disturbances of the aquatic ecosystem in the samples that were collected at the very end of the field study (when the aquatic ecosystems are disturbed maximally). We will then quantify the same metabolites in much older samples, with a view to identifying how early on we are able to detect disturbances. Our expectations? The negative effects of both thiacloprid and red swamp crayfish can be identified early on – during the slow deterioration phase – in the ditch eMetabolome (4, 7).

Delivering on promises, recognizing weaknesses

Our study is certainly specific, but we hope the project will demonstrate the strengths of eMetabolomics more broadly. Equally, we know it will challenge us to seek working solutions to four serious challenges:

- Metabolite identification. The human metabolome database currently contains 114,008 metabolites (2). A community metabolome (the result of many organisms living together in an ecosystem) will likely contain many more metabolites – and a database is currently lacking (7).
- Establishing causal relationships between specific metabolites and specific organisms in a highly complex sample, such as the community metabolome, will not be straightforward.
- Measuring the community metabolome. In doing so, we must develop innovative, on-site sampling techniques and specific preparation methods for various (and sometimes new) sample types (surface water, air, organisms).
- Education. Because (e)Metabolomics is a relatively new but rapidly growing research area, educating and training new technicians and researchers is important. At the University of Applied Sciences Leiden, we have developed a degree course in metabolomics specifically to address this final challenge.

By forging a stronger link between scientists (analytical chemists, environmental scientists, and ecologists) and professional bodies (governments, ecological consultancy firms, water boards), we believe our research and education can help contribute to a healthier living environment – one in which both people and nature can coexist in the best of health.

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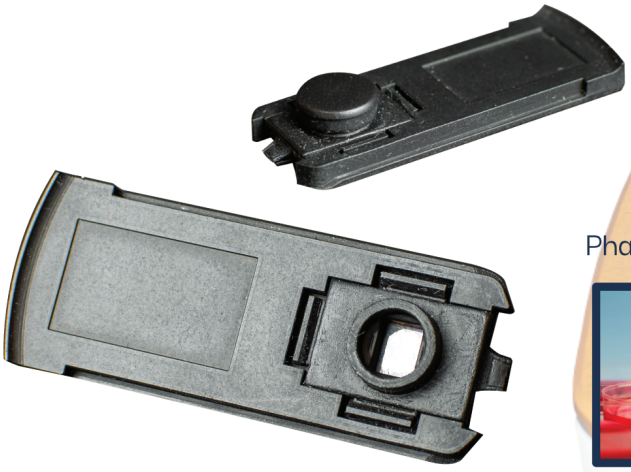
THE ARROW

Silicon ATR Consumable Slide

Analysis of Packaging adhesives



The Arrow applications

Pharmaceutical Petrochemical Life Science Glues

Did you know that your crisps packets, drink pouches or even dog food packaging are made of many polymer layers stuck together by glue to optimise mechanical and barrier properties? Conventional Lamination Adhesives used in multi-layered flexible packaging are commonly a product of solvent-based or solvent free two-pot systems that undergo the following reaction:

Polyol (-OH) + Isocyanate (-N=C=O)➡Polyurethane lamination adhesive (-NHCOO-)

The packaging industry often use FTIR to screen test the decay rate of isocyanate (NCO) in a freshly applied adhesive because unreacted aromatic NCO molecules can migrate through laminated packaging into food to react with water molecules, generating carcinogenic primary aromatic amines that are harmful to humans and pets alike! By measuring the reduction of NCO absorbance peak height over time at ~2270-2250 cm-1, this decay serves as an indicator for adhesive curing speed and food packaging safety. The spectra below were taken over time from the same solvent free adhesive on a single Arrow slide:

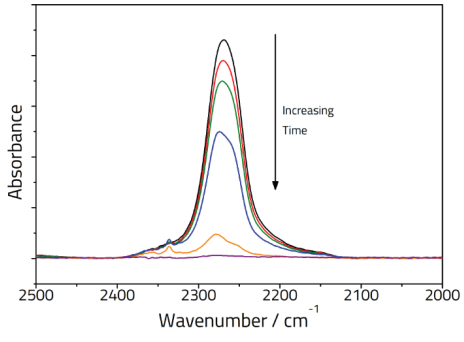


Fig1. Decay of NCO in absorbance mode over time in a two-pot packaging adhesive at standard mix ratio

Multiple Arrow Slides can also be used to compare the curing speed of different adhesives at the same time. Adhesive curing speed has many variables like OH to NCO mix ratio, curing temperature, relative humidity, the crosslink-ability of starting components and the reactivity of the aromatic NCO component amongst other factors. Sometimes the curing process can take days or even weeks, so to have just one conventional crystal ATR puck occupied for prolonged periods might not be coolest idea! High volume batch sampling using Arrow consumable ATR Slides can really save you time and speed up your work to make your organisation more competitive! Furthermore, once the polyurethane product is formed on your crystal, it could be difficult to remove and you might run the risk of damaging a relatively more expensive crystal puck; after all glue is designed to stick! So, the next time you test a sticky adhesive, varnish, paint, ink, or coating, why not give the Arrow a go?

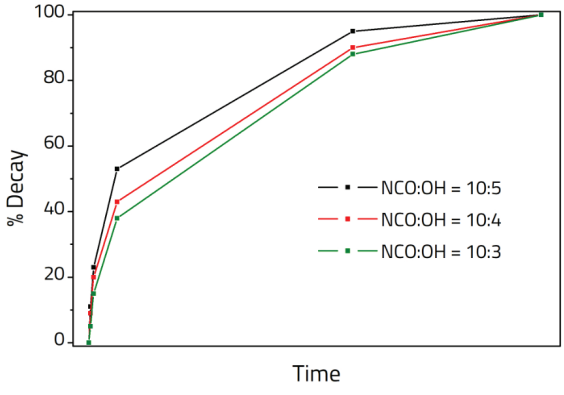


Fig2. Curing speed of adhesives at different mix ratios

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A New Era in LC Column-to-Column Reproducibility

In the application note the exceptional column-to-column reproducibility of µPAC™ columns is described and compared to state-of-the art commercially available packed bed column alternatives.

Jeff Op de Beeck, Geert Van Raemdonck and Paul Jacobs

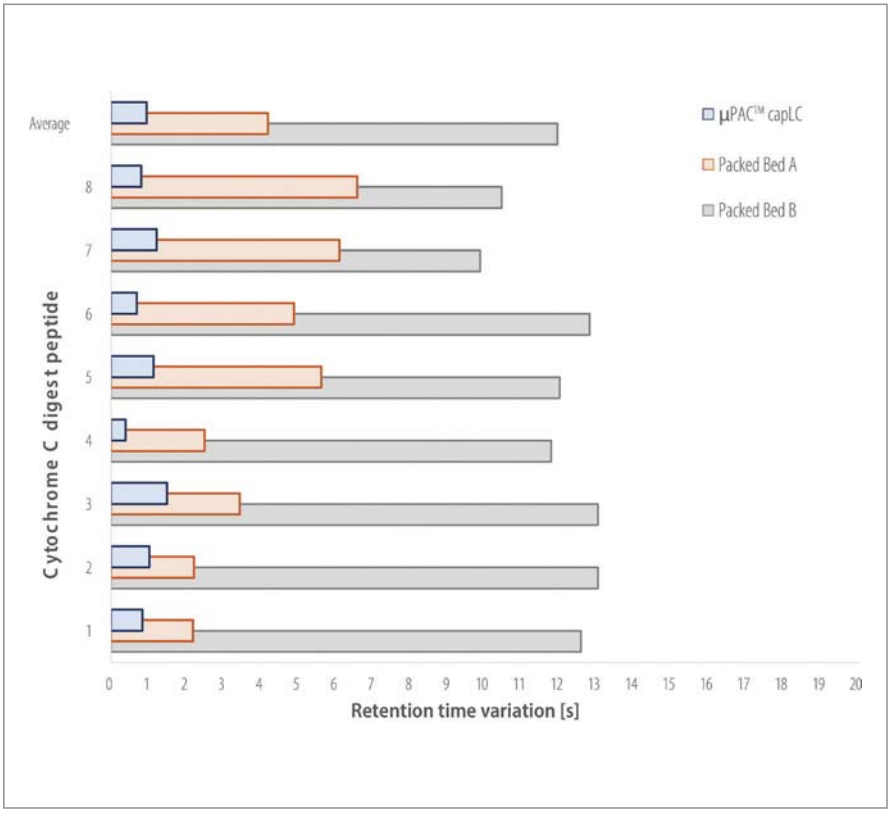

Figure 1. Comparison of the inter-column RT variation observed for eight peptides originating from cytochrome c digest for all column types evaluated.

The importance of establishing robust and reliable analytical methods is of paramount importance in today's life science research and the (bio) pharmaceutical industry. Liquid chromatography (LC), either coupled with UV detection or mass spectrometry has a prominent position within biomarker discovery and quality control workflows. Among other factors, the quality of the LC column has a significant impact on the data reproducibility and thus the method robustness. LC columns are typically fabricated by packing spherical silica particles into a cylindrical column. Even though column technology has improved enormously in the past decades, batch-to-batch repeatability is still a critical issue that can have a serious impact on LC workflow robustness. By using an entirely different LC column fabrication process, PharmaFluidics brings an extremely robust alternative to the LC column market, called micro Pillar Array Columns (µPAC™).

In this study the column-to-column reproducibility of µPAC™ columns is compared to state-of-the art commercially available packed bed column alternatives. Reversed phase capillary LC analysis of a protein tryptic digest is performed on a series of columns (three column types, n=3), and column-to-column reproducibility is compared in terms of retention time, efficiency and peak shape.

The most critical parameter when comparing column-to-column reproducibility is the retention time (RT) that is achieved for the different compounds in a sample. Whereas state-of-the art packed bed alternatives show absolute RT variation values in the order of 5–12s on average, sub second variation (0.95s on average) is achieved with the µPAC™ columns. This results in a relative variation in retention time of 0.24 (%CV), compared to 0.62 and 2.02 for the packed bed alternatives, which is up to three times more reproducible. Regarding efficiency, average peak widths of 0.13min were obtained for the µPAC™ column, whereas this was 0.15min for both packed bed alternatives.

In conclusion, whereas state-of-the-art LC columns show RT variation values in the order of 5–12s, sub second variation was achieved with three different µPAC™ capLC columns. With values down to 0.24 percent CV on three different columns, this approaches what can be achieved on just a single conventional column, highlighting the unique potential for standardizing analytical procedures. In addition to the inter column RT consistency, excellent and consistent separation performance is demonstrated for tryptic digest samples, generating highly symmetrical peptide peaks.

Weather-Induced Degradation Study of High Density Polyethylene Using the Photoprobe

Karen Sam

Introduction

Three mechanisms of polymer degradation have been known as enzymatic, hydrolytic and oxidative. The oxidative degradation is caused by free radicals that are formed by the ultraviolet radiation from the sun at elevated temperature. These free radicals lead to bond cleavage in the polymer chains in the presence of oxygen. Traditional degradation study takes from hours to days to complete due to limited light intensity. CDS's Photoprobe uses free-space focusing technology improving the light intensity to 800 mW/mm2 within 260–400 nm irradiation wavelength, which reduces the time on weather-induced degradation study down to minutes.

Experimental parameters

A CDS 6200 Pyroprobe equipped with Drop-In-Sample Chamber (DISC) and Photoprobe was used, and an autosampler module was installed to automate the sequence. High Density Polyethylene (HDPE) of 120 µg was irradiated in the DISC with the presence of air as a reactant gas. The volatiles generated from the photo-reaction were trapped on the analytical trap, and then desorbed to the GC/MS after the photo reaction is completed. Evolved gas analysis was also performed on the original and irradiated HDPE to observe how it had changed. A DISC quartz tube was used as the sample vessel.

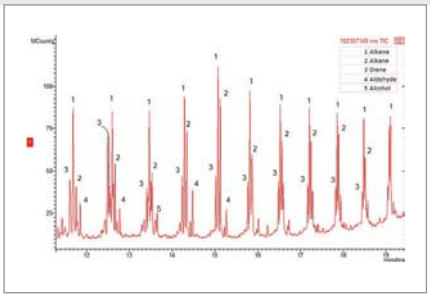

Figure 1. Photo Oxidative Degradation Products of HDPE.

Method 1: Weathering

Pyroprobe

DISC Chamber:	60°C
Photoprobe:	
UV irradiation:	*30min*
Reactant Gas:	Air 25mL/min
Trap Rest:	40°C
Trap Final:	300°C 3min
Interface:	300°C
Transfer Line:	350°C
Valve Oven:	350°C

GC-MS

Column:	5% phenyl (30m x 0.25mm)
Carrier:	Helium, 1.00mL/min
	20:1 split
Injector:	320°C
Oven:	40°C for 2 minutes 12°C/min to 320°C
Mass Range:	35–600amu

Method 2: EGA

DISC Chamber:	
Initial:	*100°C*
Final:	800°C
Ramp:	100°C per min
Interface:	300°C
Valve Oven:	300°C

GC-MS

Column:	none: fused silica 1m
Carrier:	Helium, 80:1 split
Column Flow:	1.25mL/min
Injector:	300°C
Oven:	Isothermal 300°C
Mass Range:	35–600amu

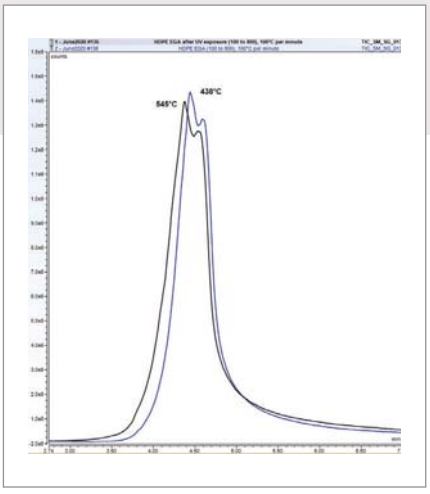

Figure 2. EGA overlay of HDPE (blue), and irradiated HDPE (black).

Results and discussion

HDPE under UV irradiation and an air atmosphere at a 60°C setpoint produced triplicate peaks associated with random scission of the polymer backbone. Small amounts of aldehydes and alcohols are also present, shown in Figure 1.

Near UV light has enough energy to break most common chemical bonds, like the C-C bonds found in HDPE. Once this occurs, free radicals are formed, which can form hydroperoxides (R-O-O·) when oxygen from the atmosphere, is added to the free radical. This radical grabs a hydrogen to form a hydroperoxide (R-O-O-H), which can decompose to form an alkoxy radical (R-O·). The alkoxy radical can stabilize by forming a double bond with beta scission, creating an aldehyde (R=O), or by abstracting a hydrogen to form an alcohol (R-OH).

When photo-oxidated HDPE is compared to unaltered HDPE using Evolved Gas Analysis (EGA), the peak attributed to random scission of the polymer backbone has decreased by 7°C indicating that its thermal decomposition temperature has decreased by the same amount.

Conclusion

In addition to analytical pyrolysis, the Photoprobe, the newest addition to the Pyroprobe, can perform online weathering studies with hours of time saved in the UV irradiation step.

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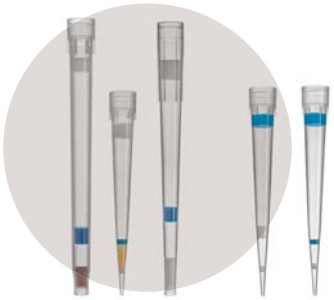

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Sitting Down With…
Nadine Ritter, President, Global Biotech Experts, MD, USA

Who inspired you to pursue a career in science?

Back in the 1960s and 1970s, children's after-school cartoons in the USA were accompanied by a mascot-type character. New Orleans had a mascot known as "Morgus the Magnificent." Morgus wore a lab coat and had a gothic laboratory filled with bubbling beakers and funny-looking lab assistants. I was totally engrossed by it all. Ever since then, I longed for a life in the laboratory.

How was the landscape for women in science back then?

Women faced many difficulties in the early 1970s – particularly in funded academic research. Funding was difficult to acquire and women's research was rarely reviewed. In the 1980s a group of women from the NIH formed a professional society to combat the issue: The Association for Women in Science. I became actively involved during my college years in Houston. I soon found myself leading the Houston chapter, and later the chapter in Chicago. We focused on mentoring young women in science by helping them to obtain the information and skills needed to conduct their research. We also advised on how to deliver talks, organize meetings, and manage teams; many pioneering women scientists were involved in this effort, and I was fortunate to work alongside them and learn from them.

When did you move into pharma analysis?

I trained as a protein chemist and molecular biologist at Rice University in Houston, and worked for over a decade at one of the biggest medical complexes in the world: UTHSC-Houston. There was no modern recombinant biotechnology industry at that time, but the 1980s ushered in a boom regarding our ability to scale up and express target proteins like monoclonal antibodies. It was then that I made the switch from academia to industry to work in biopharma analysis, after being recruited to work as a protein chemist at Abbott Laboratories.

Did you ever anticipate the move from academia to industry?

No – I thought I'd spend my entire career in academia, eventually becoming a beloved faculty member at a prestigious university, giving profound lectures to adoring students – just like my own favorite professors! But NIH funding was tight. It was a challenging time and a future in academic research was uncertain. It made sense to move to a new position in industry with people whom I trusted, but it was a scary transition. At that time, leaving academia meant you no longer existed. Many colleagues warned me that I was "giving up." I'd say that I wasn't giving up, I was going to do the same protein chemistry, just in a more applied manner.

How did you find the move to applied biotechnology?

This area is both intellectually challenging and essential. The basic research I had been conducting could never help a patient without going through product development and clinical trials. Academic research and developmental research are complementary; one cannot exist without the other. In my new role, analytical methods developed and validated in our group monitored the quality and purity of materials used in clinical trials to establish safety and efficacy in patients. When a product was approved, these methods continued to monitor quality and stability of each batch. I eventually started training others in protein analytics and lab quality practices. Ironically, I've probably ended up giving more lectures than I would have if I had stayed in academia! It's all been great fun.

You have your own business now – how did that happen?

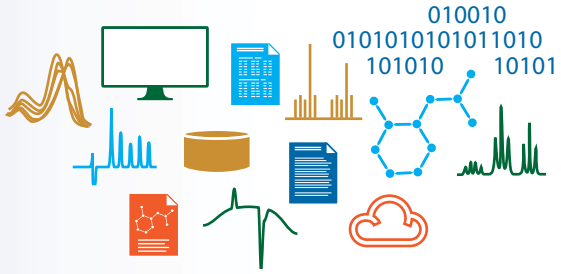
In the late 1990s biopharma CROs began to emerge for contract analytical testing. I moved from Abbott Laboratories to become Director of Analytical Services at BioReliance (Maryland). After several years the company reorganized and that lab was closed. I started applying for normal lab jobs again, but my phone kept ringing with consulting requests from previous clients. It turned out many folks needed a biologics analytical expert to help with other product development or lab inspection issues!

As President of my own consulting company – Global Biotech Experts – I provide consulting and training on technical, quality and regulatory issues for all types of analytical issues for biological products. These are areas in which I've got a tremendous amount of personal experience, and it's very rewarding to share my expertise to help others understand which analyses are needed and when. My goal is to help them avoid making the same mistakes as others have made (including me!).

Do you have any roles outside of your company?

I act as President of the California Separations Sciences Society – a group of biotechnology CMC regulatory and technical experts with whom I've been involved for over 20 years. We host meetings with regulators from agencies such as the FDA (US), EMA (EU), HC (Canada) and MHRA (UK), and also host the CASSS CMC Strategy Forums – annual meetings to discuss biopharmaceutical products with invited experts. The result is an annual publication outlining our recommendations for best practice. I'm also involved in the Parenteral Drug Association, am on the Editorial Board of BioProcess International, and was a member of the Biologics Advisory Board (BioAB) for several years.

Transform Analytical Data into Accessible Shareable Knowledge



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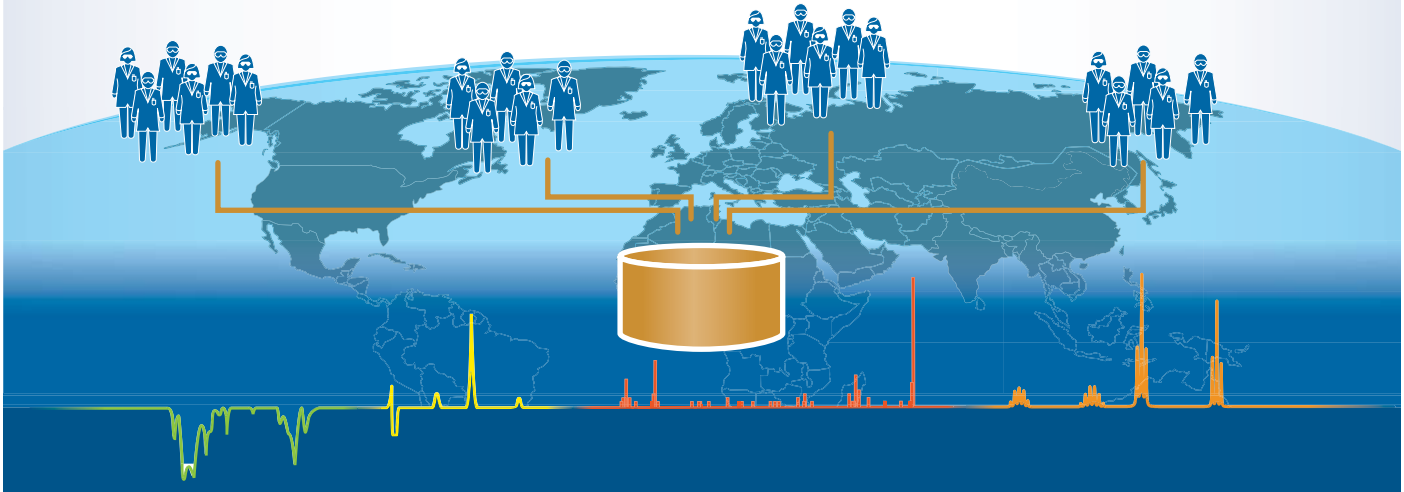

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