FACES OF MASS SPECTROMETRY / Robert 'Chip' Cody

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August 2018

The Ambient Condition

Even though Robert 'Chip' Cody has invented a number of techniques critical for analytical chemistry, many are unaware of at least part of his influence. Perhaps it is because his work routinely relies on a pool of surrounding talent and collaboration. Perhaps it is the fact that he has worked in industry since 1982, mostly as a product manager for JEOL USA, Inc. Or perhaps it is his self-deprecating manner: after mentioning that DART, which he co-invented and patented in 2003, won the PittCon Editor's Gold Award in 2005, he quickly digresses with something that he finds more fun: current consulting for NASA's Mars 2020 Rover Project.

"The rover will drill core samples and stash them until they can be brought back to Earth on a second mission," says Cody, words flowing rapidly and stopping only to accentuate wry comments. "It is going to be really exciting; nothing has ever come back from Mars before."

Cody received his doctorate in Analytical Chemistry from Purdue University where he worked under Ben Freiser. His first position was at Nicolet Analytical Instruments, but in 1989 he moved to JEOL.

"It's been very good . . . they continue to let me work in the lab," Cody pauses for effect. Cody's research has covered numerous topics, detecting everything from human growth hormone to uranium isotopes. His contributions to mass spectrometry garnered him the ANACHEM Award in 2011, and his publication record is "somewhere between 100 and 200 papers. I often just write up application notes that others use to publish."

What is your major contribution to mass spectrometry?

I am best known for co-inventing direct analysis in real time, or DART. But honestly, I think that one of the more important things is something that most people don't know: the trapped-ion MSn experiment (Cody and Freiser, *Int. J. Mass Spec. & Ion Physics*, **1982**, 41, 199-204 and Cody, et al., *Anal. Chem.* **1982**, 54, 2225-2228). That is, the whole idea of trapping ions in a mass spectrometer, fragmenting them, and then doing chemistry with them, either breaking them apart or reacting them further.

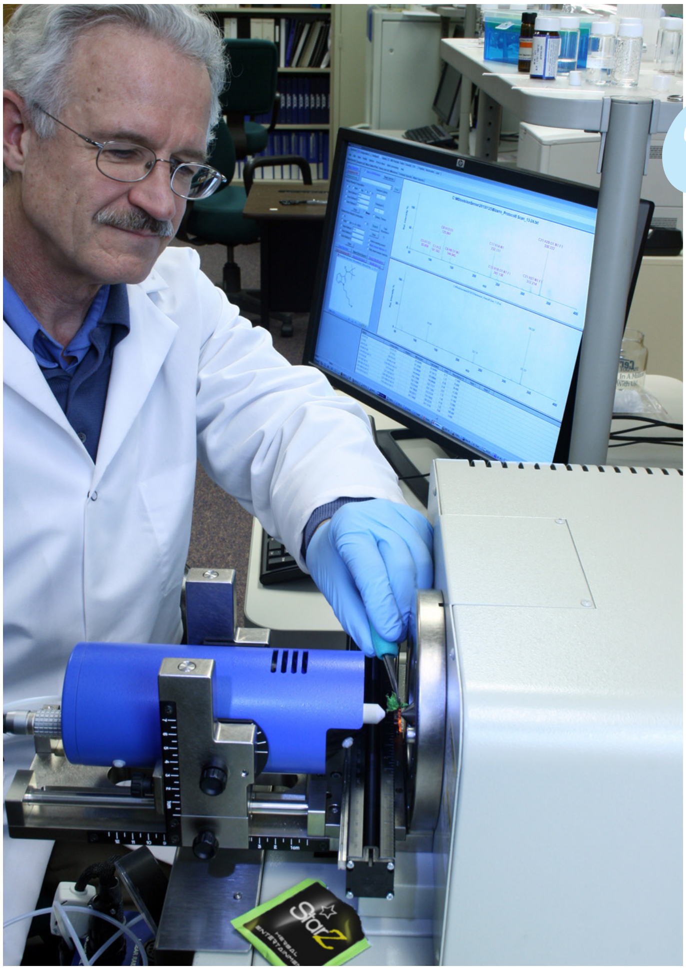
I was one of Ben Freiser's first graduate students at Purdue – in fact, he arrived the same time as I did and was one day, one month and one year older than me. My thesis included the trapped ion method developed on the Fourier Transform Mass Spectrometry (FTMS) system that Ben bought, as well as laser desorption of metal ions in the trapped-ion mass spectrometer, and a trick that traps ions and collides them with electrons that we called Electron Impact Excitation of Ions from Organics, or EIEIO (Cody and Freiser, *Anal. Chem.*, **1979**, 51, 547–551). It was a little tough to get it through review the first time, but we managed to get away with the crazy acronym. Over the years, I've worked with various mass analyzers, ion activation methods, different ion sources and chromatography, as well as applications and data analysis methods.

How did you get started in analytical chemistry?

I studied chemistry when I went to Roanoke College. They really didn't have much in the way of mass spectrometry, so my one MS experience was sealing vacuum leaks in a glass bulb inlet in an old trochoidal mass spectrometer gas analyzer that was lying around. It was really primitive: fixing it involved Popsicle sticks, a vacuum sealer and a Tesla coil. Mass spectrometry always appealed to me because I liked the logic of adding and subtracting the masses of the ions to figure out the structure of molecules.

What did you do after graduate school?

I spent seven years with Nicolet Analytical Instruments in the FTMS Group. We did quite a bit; at one point Alan Marshall said I'd measured more Fourier transform mass



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spectra than anyone else in the world. When Nicolet sold off the mass spec group, I took the opportunity to work at JEOL where I've been for 30 years. It was at JEOL that I developed DART with a former Purdue colleague, Jim Laramée, who was looking for a nonradioactive ion source for use with chemical weapons sensors (Cody, Laramée and Durst, *Anal. Chem.*, **2005**, 77, 2297–2302). We filed the first DART patent in 2003, but Jim convinced me to keep the whole thing secret. It stayed secret until the DESI (desorption electrospray ionization) paper from Graham Cooks' group was published at the end of 2004. Graham Cooks and I gave back-to back talks at the annual ASMS conference in Florida just after this. It was really quite exciting because the two techniques are complementary and opened a whole new field for mass spectrometry.

What interesting research are you working on now?

Oh, gosh, there are so many things. DART was originally good for small molecules with a molecular weight of 1000 or 2000 or less, but we keep finding new way to apply it and complementary ambient ionization methods to a wider range of analytical problems. DART can be applied to all kinds of things: food, synthetics, drugs, explosives, and even classification. For example, Ed Espinoza at Fish and Wildlife Forensic Services uses DART to detect illegally imported hardwood. Rabi Musah at U. Albany, another collaborator, wanted to analyze the bad smell emitted when a mimosa plant is pulled from the ground, so we trapped and identified these short-lived compounds with SPME and DART. We even collaborated with the electron microscope guys at JEOL to find out what the plant structures releasing these gases look like (Musah, et al., *Plant Physiol*., **2016**, 170, 1075–1089). More recently, Rabi's group developed a laser ablation DART imaging technique to scan an object under atmospheric pressure to create an image (Fowble, et al., *Anal. Chem.*, **2017**, 89, 3421-3429).

Collaboration has been the best part of the job. We never know what sample is going to come in the door. I get to work on so many different things with interesting challenges to think about. What is exciting is that, over the years, we've developed ways to do things with technology that we couldn't have done years before. Sometimes I get asked if something can be done with DART and my first reaction is "No." Then I'll go to a conference and see a poster and find that someone's done what I thought wasn't possible. It is really fun to see what people are developing independently.

What do you do outside of the lab?

For many years, I played keyboards in a band, but I haven't done that for quite a while. Recently, I've been doing triathlons. And I home brew, making porters, stouts and IPAs. I liked a recent New England IPA—made with Citra, Lemon Drop and Mosaic dry hops —so much that I took a SPME fiber home and stuck it in the airlock above the fermenter to find out why it smelled so good. It is funny, the things you can do when you get to play with expensive toys!