

FACES OF MASS SPECTROMETRY

Amanda Patrick



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Sharing Tricks of the Trade

Amanda Patrick became interested in mass spectrometry while earning her PhD in analytical chemistry at the University of Florida. After working as a postdoctoral researcher at the Air Force Research Laboratory, Space Vehicles Directorate, Amanda decided to pursue a career in academia. She now works as an Associate Professor at Mississippi State University in the Department of Chemistry. There her research group focuses on both analyzing degradation products from ionic liquids and developing mass spectrometry methods to differentiate isomers and isobars. Amanda enjoys this position because it is a fulfilling balance of research, teaching, and outreach. In addition, it has allowed her to collaborate on a diverse range of scientific topics and applications.

As a scientist and professor, Amanda is a firm believer in the value of both outreach and mentorship. She prioritizes these merits within her research group and participates in several initiatives set up to reach broader audiences like the ASMS mock interview program, and "Letters to a Pre-Scientist" a K-12 outreach pen-pal program. In 2022, Amanda was named a Cottrell Scholar which honors outstanding teacher-scholars within the scientific community. As part of this distinction, she

developed a communication workshop for scientists which facilitates open discussions on professional development topics for student researchers such as resumé writing and job applications. Through her work as a Cottrell Scholar, Amanda continues to contribute to the mission of enacting positive changes in academia, both in chemistry and in physics.

Before pursuing your undergraduate education, did you always know that you wanted a career path in science?

As a kid, I was drawn to science, but initially I thought I wanted to do something with animals like zoology or veterinary medicine. During high school I had an excellent chemistry teacher and that was when I first realized chemistry might be the path for me. When I did my undergraduate studies in chemistry, that sealed the deal.

We understand that your interest in mass spectrometry started with your PhD at the University of Florida. What inspired that interest?

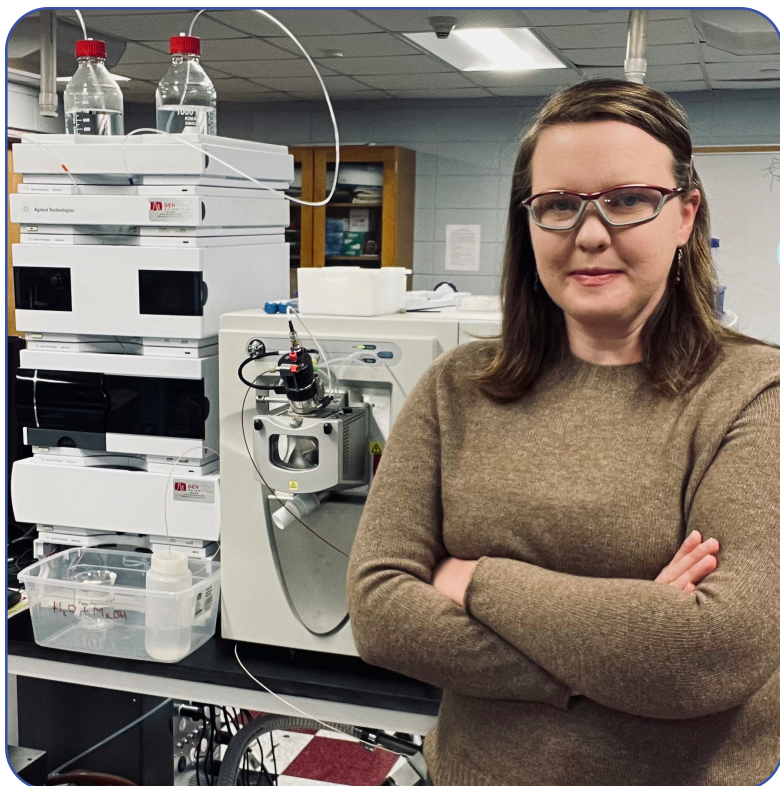
During my undergraduate studies, I did research in a synthetic lab. I realized then that I prefer the instrumental analysis side of the work, which is to say: analyzing products rather than making them. As I started learning about the different areas and career prospects within analytical chemistry, I heard about the exciting mass spec research that was underway at the University of Florida. Overall, I was really impressed by the ubiquity of mass spectrometry and the flexibility and versatility of the platform, and I decided to pursue it as the focus for my PhD at the University of Florida. There I studied analytical chemistry and instrumental analysis. In my graduate research, I performed infrared ion spectroscopy on mass-selected ions within a mass spectrometer. The innovative aspect of using ion traps for spectroscopy experiments was exciting to me.

What made you pursue a career in academia and your current position at Mississippi State University?

In between getting my PhD at the University of Florida and coming to Mississippi State, I was a postdoctoral researcher at the Air Force Research Laboratory (AFRL), Space Vehicles Directorate. Throughout my education, it was my dream to land a government position. Yet, when I got to AFRL, I realized that despite enjoying the science, I really missed the presence of students. This realization is what inspired me to look for a permanent position in academia. I sought out tenure track positions in the Southeastern US and found this one at Mississippi State. I really enjoy the balance of research, teaching, and outreach I get to do here.

What is the focus of your current work at Mississippi State?

Much of my research work here at Mississippi State has been influenced by my time at AFRL. When I was there, I was studying



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Amanda Patrick in her lab at Mississippi State University, with an LC-MS instrument in the background. (Photo courtesy of Amanda Patrick.)

ionic liquid behavior for electrospray-based spacecraft propulsion systems. We quickly realized that there were a lot of pieces to the puzzle on the fundamental science side that were missing. I have been trying to work to fill in gaps in the literature to improve our understanding of ionic liquids. This is the primary focus of our group right now.

What opportunities for research collaboration have you encountered while working at Mississippi State?

I am one of the few mass spectrometrists on my campus, which means often when someone has an interesting mass spec idea or needs to do advanced experiments, they end up in my office. This has allowed me to work on a variety of different projects, ranging from characterizing organometallic complexes to quantifying flavor compounds in different aging methods of beef products. It has also made it possible for us to help develop undergraduate laboratories for chemical education-based research. It has been interesting to have a chance to expand my horizons for the many different applications of mass spectrometry, while also helping to showcase the utility of mass spectrometry to folks around my campus.

Tell us how applying mass spectrometry to ionic liquids aligns with your current research efforts.

While I was at AFRL, we realized that there was a lot of fundamental science to study at the nexus of ionic liquids and mass spectrometry. Therefore, here at Mississippi State, we have been tackling this from several different angles. The first thing we did was lay the groundwork for understanding gas phase dissociation pathways as a function of the cation scaffold and its substituents. This work provided the basis for all our future and ongoing work. We have several current projects on ionic liquids. One project focuses on degradation

products from ionic liquids when they are subjected to high temperatures. This research impacts several different areas, such as informing our understanding of ionic liquid stability for high-temperature applications and understanding what kinds of degradation products might be formed in the context of potential environmental contamination. Another major project we are getting started on focuses on the potential environmental impacts of ionic liquids. This project is focused on developing various mass spectrometry methods to characterize and detect ionic liquids in different samples.

Can you tell us about your experiences mentoring young scientists?

Personally, I benefited greatly from being mentored by various people, but I felt some aspects of academia and scientific careers were not very transparent. I have been striving to be as helpful and open as a mentor as possible within my research group. I have also worked to mentor young scientists across various ages and career stages. In my group, mentoring includes basic topics like helping with writing and scientific efforts. It also includes encouraging students to take advantage of leadership development academies and summer schools; programs that will help them broaden their horizons and become better positioned for their careers. At the end of the day, I want my students to be well-rounded scientific citizens beyond my research group. Examples of mentoring folks outside my research group have included volunteering with K-12 outreach. I also serve as an interviewer for ASMS’s mock interview program to help students navigate that process, in a low-stakes environment. In my experience, being transparent, open, and answering younger scientist’s questions is key to mentoring.



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Combining interests in chemical detection and dog training, Amanda Patrick handles her dog, Percy, in scent work. (Photo courtesy of Amanda Patrick.)

What made you decide to get involved with “Letters to a Pre-Scientist” a pen-pal exchange with K-12 students?

I think it is important to have outreach efforts not only aimed at those who already have that deep interest in science, like scientists early in their career or education, but also outreach aimed at the general public. I really want to focus on helping the public have an appreciation for science and an understanding of the scientific method, going beyond those who will actively pursue a career path in scientific work. The organization entitled “Letters to a Pre-Scientist” is a really cool nonprofit that I volunteer with. It facilitates pen-pal exchanges between entire classes and an equal number of volunteer STEM professionals around the world. There are a lot of teachers aligning this with their science curriculum and tying it into other learning objectives like writing or geography. This is

an outreach style that I appreciate, one which is very inclusive. As a scientist, it is a fun way to share your career path with a totally different audience than you might reach in your day-to-day work. In terms of the diversity and inclusiveness aspect, because every student in a class is paired with their own STEM professional, it allows the class collectively to meet a lot of different scientists from diverse backgrounds and with various types of careers.

What are the ways you help students navigate science writing and the job search?

As I progressed through my career, I realized there were a lot of things I did not feel prepared for as a scientist; from attending my first conference, to applying for jobs, to negotiating start-up packages. With my own research group, I try to be both approachable and transparent. In my group in terms of preparation, we often talk about the unwritten and unspoken

rules in this field. To reach a broader audience, I developed a hidden-curriculum and science communication workshop that facilitates some of these open discussions for research-active students across our department. In addition to general scientific writing, we talk about topics ranging from resume writing to the “dos and don’ts” of research and teaching statements for job applications. A lot of the workshop conversation is driven by individual cohorts’ interests and curiosities as well as the guest speakers who we invite to participate.

You have been a member of ASMS since 2012, how has your membership helped you to grow and learn as a scientist?

One of the most important aspects of ASMS, beyond the fascinating science at the conferences, is the strong sense of community and mutual support among its members. Whether it is #TeamMassSpec on social media or participating in the in-person programs, there is a great camaraderie within the mass spec community that ASMS promotes and facilitates. I feel like I have really gained so much from this community as an early-career researcher. Now, I am thrilled that I am starting to be able to give back through volunteering for mock interviews at the annual conference and serving on ASMS committees.

We understand you were named as a Cottrell Scholar in 2022. What did this honor entail?

The Cottrell Scholars Program starts with a three-year grant. The hallmark of the grant is that it includes two parts: funding for a

research project and an educational innovation. A portion of my educational contribution is the hidden curriculum and science communication workshop I developed, which I mentioned earlier. Also, the Cottrell Scholars community meets annually to discuss endeavors and ideas toward enacting positive cultural change in academia, both in chemistry and in physics. It also focuses on improving both teaching and mentoring. Like ASMS, the Cottrell Scholars Program has provided a great community and a positive outlook, both as a scientist and as a professor.

When you are outside of the lab and not working, what kinds of activities do you enjoy most?

I like to go out in nature, doing things like hiking and exploring. I am a total dog person. Throughout my scientific training, I have volunteered with various animal rescue groups; mainly those that work with dogs. Now that I have a permanent position, I have my own dog, an eight-year-old Australian cattle dog named Percy. We have earned various trick titles and do a lot of obedience training and scent work (Figure 2). The scent work is really cool in that dogs can be readily trained to respond to a specific odor. I enjoy scent work training, because it combines dog training and analytical chemistry or molecular detection—two of my big passions!