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Women in Microwaves: Rhonda Franklin

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(Special Series Paper)

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ABSTRACT When Rhonda Franklin earned her doctorate in 1995, she was one of only six African-Americans graduating with engineering PhDs in the United States. When she was tenured and promoted to an associate professor at the University of Minnesota in 2004, she was the first female of any race to earn tenure in her department from the rank of assistant professor and the first African American female tenured in the college. Today, Franklin is the McKnight Presidential Endowed Professor in the Department of Electrical and Computer Engineering at Minnesota and Abbott Professor of Innovative Education in the Institute for Engineering in Medicine. Her research focuses on circuits, antennas, integration and packaging and materials characterization in radio frequency (RF), microwave and milli wave applications related to communications systems and biomedicine. This article is the third in a continuing series of biographical pieces on women who have made significant and continuous contributions to microwave science, technology, applications, and education over the course of their careers. The articles are based on oral histories with the subject, conducted in conjunction with the IEEE History Center and deposited online with the Engineering and Technology History Wiki.

INDEX TERMS African-American, education, gender studies, intersectionality, MEMS, nanotechnology, oral history, pioneer.

I. DOCUMENTING THE CONTRIBUTION OF WOMEN

Before I ever sat down with Rhonda Franklin to record her oral history,[1] she had already been thinking about how to archive the contributions of women to microwaves. As the event chair for the 2021 International Microwave Symposium (IMS2021) Women in Microwaves (WIM), which was held as a virtual event due to the Covid-19 global pandemic, she embarked on a three-part plan.

First, Franklin invited a small group of women to record short video presentations [1]. They were just snippets, sound-bites, but the goal was to show how the field had evolved since Franklin attended her first WIM event as a graduate student in the mid-1990s. Back then, Franklin could count the number of women in the field on two hands. Now the WIM event is much larger, but many of the original pioneering women were beginning to age into retirement. Before that happened, Franklin wanted to pay them due respects. These women created the roads that she had travelled, and Franklin wanted to capture their presence.

But Franklin was not only thinking about the past. She wanted to shift the conversation. Too often gendered discussions focus on what's wrong, and too frequently careers can get bogged down in distracting commitments. Franklin wanted women to see a pathway to the top. For the second part of her plan, she initiated a project, led by one of her graduate students and a research associate in Italy, to interview women leaders around the world who contribute to microwaves [2]. *What's the Next Big Thing* was the result. This 10-minute video gave a flavor of the current leadership in the WIM community. It was designed to help women see IEEE in the context of regions, giving voices to women dispersed all over the world. Because the number of women in the field remains proportionally small, it can easily be diluted when viewed as a whole. She wanted a way for young professionals to be introduced to leaders through alternative means [3].

[1]Rhonda Franklin, an oral history conducted in 2021 by Allison Marsh, Interview #861, IEEE History Center, Hoboken, NJ, USA. Note that this oral history was recorded in two parts on two different days. Part one was recorded 27 July 2021, and part two was recorded on 23 August 2021, yet they are archived with the IEEE History Center as a single interview, #861. In this article, they will be cited as Oral History, Part 1 or Oral History, Part 2.

Finally, Franklin's third part, which she admitted was less well documented than the clearly archivable videos, focused on facilitating a multi-generational conversation between senior women and young professionals. By discussing topics such as leadership, strategies for success, and overcoming obstacles, she aimed to inspire the next generation and provide them with insights and solutions. Additionally, implicit in these discussions was the exploration of the needs and wants of the next generation, which Franklin recognized might differ from the past [3].

A surprise outcome of the intergenerational conversations, at least for Franklin, was that many of the young women didn't understand why there was a focus on the female experience. It was not as though these women were anti-feminist, it was just that they had not experienced much of the explicit discrimination that their predecessors had. Recognizing the lack of awareness about historical challenges, Franklin was ready to sit for her oral history and reflect on her path to success.

II. ROOTS

Rhonda Franklin was born in Rayne, Louisiana. Both of her parents were raised in very low income households in the segregated US South. Both sets of grandparents highly valued education, even though they themselves had limited formal schooling, and encouraged their children to go to college. Franklin's parents became first generation college graduates. Her mother, Ann Marie (St. Julien) Franklin, majored in math education with a minor in biology, and her father, Elvin Franklin, Jr., majored in industrial education. When they received their degrees in the early 1960s, their world changed seemingly overnight. Suddenly they were like millionaires, compared to their standard of living before. With the passage of civil rights legislation in 1964, the doors of integrated America opened [3].

Up until the age of about seven, Franklin lived in predominantly African American neighborhoods in Shreveport, Louisiana, and Houston, Texas. When her father was able to get a job in management with Gulf Oil, they moved to a predominantly white, middle class neighborhood in Houston, Texas. Elvin Franklin then became self-employed, opening up an insurance agency. As only the second African American State Farm Insurance agent in Texas, he had secured the family's position in the middle class, even though he continued to face racism and discrimination [3].

Over the next few years, while Rhonda Franklin was enrolled in the local primary school, the neighborhood, underwent a complete racial turnover as white flight took root. She went from having all white teachers to all black ones in a short amount of time.

Franklin was a typical overextended, overachieving student. She did ballet from age seven to 18 and music from sixth through twelfth grades. She played the trumpet in the marching band, jazz band, and concert band. At the recommendation of one of her band directors, she attended summer camps and played in the Houston Youth Symphony. Always goal oriented, she remembered having a conscious goal of being president of the band, student body, and honor society. By the time she graduated middle school, she had achieved all three.

Franklin excelled in coursework. Her favorite subjects were math and science, but she also liked reading and writing. She honestly loved it all, although she found history and social studies a bit more difficult because they required memorization. She consistently won academic accolades and honors, but there was a price to be paid: bullying.

"Middle school is horrible, right?" Franklin remarked. "Kids just harass kids [3]." She was peppered with hurtful questions: Why do you talk like that? Why do you work on those kind of things? She did not let it deter her, but she never wanted to experience it again.

Of course it was not only children who said hurtful things. As Franklin excelled at the trumpet, she learned that this was not the instrument of choice for girls, who mostly played woodwinds. At band competitions she could overhear other band directors using her to spur on their own students, saying "Are you going to let that girl trumpet player out-perform you [3]?" It was not pleasant for Franklin.

Luckily, in the classroom, and especially in STEM courses, Franklin never felt the sting of sexism or racism. She absolutely credits her teachers for encouraging her academic pursuits. When she won the ARCS (Achievement Reward for College Scientists) Minnesota Scientist of the Year award in 2020, she put together a slide of all of the people who impacted her career trajectory, including her parents and grandparents, her dance coaches and band directors, and her math and physics teachers [4].

Although Franklin knew from an early age that she wanted to go to college, she did not have any specific career aspirations. She considered vaguely law or medicine, but her inability to resolve death ruled out medicine; she did not want a career that involved loss. She was unaware of STEM professions until her science teacher handed her a flyer for an engineering camp at the University of Houston the summer after her junior year. It was a turning point [3].

III. UNIVERSITY EDUCATION

The University of Texas at Austin was her first option. Franklin had a full scholarship entering her senior year of high school, but she didn't like the setting. Franklin worried about being in the city and the potential distractions; she just wanted to study. When she walked onto the campus of Texas A&M in College Station, she fell in love. In hindsight, she suspects that her parents may have worried for her safety – small town Texas only 15 years after forced integration was potentially alarming – but they never protested her choice [3].

College orientation was the first time Rhonda Franklin felt like she was a minority. She had been in situations before where she was the only brown-skinned person, such as music camps and playing with the youth symphony, but the climate at Texas A&M was different. It took her three times to be paired with a roommate because the first two requested alternative living arrangements [3].

Franklin's freshman year of college was also the first time that academic advisors began lowering their expectations for her. For example, although she qualified to enroll in calculus based on a placement exam, an advisor suggested she would feel more comfortable taking pre-calculus. Franklin stood her ground and enrolled in calculus. Two weeks later, she was in a bit of a panic because they had already covered everything she knew about the topic. She contacted one of her high school teachers who sent her three additional textbooks. She buckled down and figured it out [3].

Franklin eventually found her footing and support. She became involved in student organizations; she pledged a sorority; she led the National Society for Black Engineers club. She was a student member of IEEE and in Tau Beta Pi, although she was not in Eta Kappa Nu. Franklin always held a job or an internship, starting in the energy field, and had support from faculty to attend graduate school [3].

During her junior year, she toyed with the idea of doing a co-op at the Jet Propulsion Laboratory, but Dr. Howard Adams argued persuasively against it. He thought she was destined for graduate school, and a co-op would be too distracting; it would prolong her time in school [3]. Adams was the executive director of the National Consortium for Graduate Degrees for Minorities in Engineering and Science (GEM) [5] at the time. Instead of the co-op, he found her a summer research position at the Lawrence Livermore National Laboratory.

She loved the research environment. She loved the problems, the complexity. She loved every bit of it, except her first summer assignment in a topic she enjoyed.

That assignment in power electronics required moving around heavy pieces of equipment, which necessitated spotters. The men on her team liked to make fun of her. Franklin did not appreciate the joking, especially when safety was involved [3].

When the head of engineering asked her about her summer experience, she replied politely and professionally that it was "just okay [3]." After she explained the equipment and safety concerns, he suggested she move up in frequency, all the way to microwaves, which had smaller equipment that she could handle herself. She never looked back.

By taking the internship at Lawrence Livermore, she became an active fellowship recipient in a consortium of institutions that guaranteed student graduate funding. She was admitted to all of the graduate programs to which she applied, and she chose to attend the University of Michigan for her master's and doctoral degrees, studying under Linda Katehi [3].

At the time, Katehi was only in her fifth year of teaching and had not yet been granted tenure. Franklin applied to work with Katehi because of her research area, but one reason she chose to attend Michigan was because Katehi was the only faculty member to talk with her during the application process. Franklin reasoned that if professors were too busy to discuss the application, it probably would not work out to be a good fit for her [3].

As was documented in an oral history with Linda Katehi, these early years were professionally challenging for her [6]. Although Katehi did an admirable job of shielding her struggles from her students, Franklin was very much aware, partly because she was struggling herself.

Once again, Franklin found her community. This time it was working in Katehi's lab and with some of the international students in the graduate program. She found in common more with them because they also felt a bit out of their element. She also admired how well prepared they were based on the competitive nature of other countries' educational systems. She enjoyed working with the best of the best [3].

Franklin was the first African American women in the microwave engineering program at Michigan, and she recalled being one of only eight African-Americans (of both sexes) graduating with PhDs in electrical engineering in the United States at the time [7].

When she graduated in 1995, the economic outlook seemed terrible. Many industries were in the midst of reorganization; they were being bought and sold. With that level of uncertainty, Franklin decided on an academic career. Her first tenure track job was at the University of Illinois, Chicago. In 1998 she was recruited to the University of Minnesota, which is where she has remained. When Franklin was tenured in 2004, she was the first female of any race tenured in her department starting from the rank of assistant professor and the first African American female tenured in the college [8]. Franklin is currently the McKnight Presidential Endowed Professor in the Department of Electrical and Computer Engineering and Abbott Professor of Innovative Education in the Institute for Engineering in Medicine [9].

IV. RESEARCH

Rhonda Franklin is an experimentalist by nature, and she found working in Katehi's group, initially a theory-heavy and analytical modeling lab complemented her intellectual growth [3]. Her dissertation, *The Development and Characterization of Self-Packages Using Micromachining Techniques for High Frequency Circuit Applications,* focused on developing self-packaging at the circuit level, which involved designing packages to be integrated with the circuits themselves [10]. She explored how to bring a physical structure close to the circuit and how to design it to be non-intrusive, then how to design the structure to be part of the circuit [3]. Terahertz technology was at the center, and Franklin was fortunate to be working Michigan, which at the time had the NASA Space Center for Terahertz Technology [11].

This approach aimed to minimize interferences and optimize the use of small power available in terahertz technologies using Micro Electronic Mechanical Structures (MEMS) technology in a unique way by etching deep depths, which was different from the prevailing practices. Additionally, Franklin explored using silicon for these circuits, which was unconventional in the communications field at the time. The lack of comprehensive models for silicon-based circuits and limited tools for testing integrated circuits posed additional challenges during her research.

Franklin's dissertation work produced her first patent (co-invented with her advisor, Linda Katehi and assigned to the

University of Michigan), US 5608,263A, "Micromachined self packaged circuits for high-frequency applications." With this invention, Franklin and Katehi developed monolithically integrated cavities which provided effective shielding of specific circuit components while maintaining an overall geometry that was small enough to avoid multiple resonance excitation in the range of operating frequencies. Their preferred technique included a pair (or more) of semiconductor wafers bonded together, but they also provided an outline for how a single wafer could be used in partially shield and packaged circuit. Applications of micromachined circuits constructed in this manner would include a simple circuit component such as an antenna/array network, a tuning stub, or a filter [12].

Franklin finished her doctoral work at a time when microwaves and optics were starting to cross paths. The hot topic at the time was RF photonics, so she spent some of the early years of her career working on 2D and 3D packaging for optical applications. There were a few critical areas of overlap, such as with electrical interference to a modulator. This research led Franklin to working on problems of miniaturization, which led her into collaboration in areas of biotechnology [3].

Franklin began to build circuits that could interface with bacteria. That opened up a world of questions: what does it mean to introduce fluids to electrical systems? That's usually a clear no-no. Her group explored electronics that had fluidic interfaces, investigating how to create a functionality that was usually ignored or actively avoided in traditional electronics [3].

Early in her career at the University of Minnesota, a colleague from the Microbiology Department, Daniel Bond [13], asked Franklin if she could help him with the bacteria Geobacter sulfurreducens. Franklin took on the challenge with the question of whether she could find an electrode that was biodegradable. It was her first multidisciplinary project and led to several publications [14].

During the course of this project she realized two important perspectives when attempting to characterize the materials from the microwave point of view. The first came when the microbiologists talked about electron creation, which happened when the bacteria was growing and the cells splitting. The cells only split when they are fed. They are fed in a solution, and so Franklin could not do a direct measure in their real state because she could not put RF in water. The second realization came like a lightbulb going off: bacteria are alive. As living organisms, they need their own environment, and as an engineer she had to adapt to work on their terms [8].

This pushed Franklin to look into fluidics. It also led her to more collaborations, including one with Beth Stadler [15], who was making magnetic nanowires and was looking for a way to characterize her materials at microwave frequencies. Franklin developed diagnostic tools. Along the way, Franklin started investigating antennas as free space interconnects in packaging. She is now characterizing biomaterials that can use nanostructures like Stadler's nanowires as heaters for rewarming cryogenically cooled agents in organs, aiding organ preservation for potential transplants [8], [15].

Franklin and Stadler also began collaborating with a third woman, Rashaunda Henderson (also from Katehi's group and ultimately the President of the MTT-S Society) [17], at the University of Texas at Dallas, making it a team of three women PIs to study copper nanowires in sub-terahertz interconnects. In this group, they also had two female graduate students, one for Franklin and one for Henderson. It is a rare occurrence in the field of microwave research to have an all-female team, something Franklin never thought she would see in her lifetime, but perhaps the spark of a more gender-balanced field [8].

Franklin is proud of the research she has done. It has always been intellectually satisfying and has resulted in numerous publications and patents, but she works in an area where it is difficult to get direct feedback on how people may be using her research. Often applications of her work are embedded in the protected intellectual property of companies. It has only been indirectly when someone tells her privately that one of her articles helped solve a problem. She takes those wins, even if it is not something easily measured by external standards [8].

V. TEACHING AND THE NEXT GENERATION OF ENGINEERS

Ann Marie Franklin, Rhonda's mother, was a teacher, and Rhonda credits her as a role model [3]. Ann Marie even suggested that her daughter would be an excellent teacher, but Rhonda never planned on being one. When she was in school, she was only thinking of K-12 education, not teaching at the university level, but time and distance sometimes offers a perspective that was unclear at the moment. One of Rhonda's classmates from high school later remarked that she was always trying to teach them whatever they were learning in class. Explaining things to people, especially figuring out how to explain it in a way that people understand, that's her favorite part of being a professor. Perhaps it is much less ironic that Rhonda went into education than her younger self might have imagined [8].

Just like every professor I know, Franklin hates grading. She understands that it is part of the job and is necessary, but she hates it because she takes the time to get to know her students. That is fine when the students are successful, but it is heartbreaking when she seems them perform below what she knows they are capable of [8]. It is one of the traits that make her a successful teacher and mentor, marked by teaching awards at various stages of her career [9].

Throughout her education, Franklin has had numerous teachers and professors who gave their time and energy to mentor and encourage her. Now she is looking to see how she can do the same for the next generation of students.

Franklin has volunteered extensively with undergraduate scholarship programs, especially with student article competitions. She wants to help students understand the profession of electrical engineering and how IEEE can play a part in the development of their careers [8].

At the same time, Franklin believes that the field of electrical engineering is in crisis, yet no one has sounded the alarm. She has pinpointed physics as one of the bottlenecks into electrical engineering because it is not required, or even offered, at every high school. She recognizes that what she is witnessing is primarily a US problem – that in many places around the world physics education is more strongly integrated into the K-12 path of future engineers.

Having identified one problem, she asks, "What is the work around?" She bristles against the language suggesting it is a "pipeline problem" because the pipeline metaphor makes it seem more linear than it potentially is. She prefers the language of pathways, suggesting there are many possible routes to the field [8].

If the field does not figure out alternative pathways soon, she sees the future of electrical engineers from the United States in crisis. Although she believes that the field should be diversified globally, she worries that American electrical engineers may disappear due to a structural problem in K-12 education.

VI. ON BEING A PIONEER

When Franklin uses the word "pioneer" to describe her professional journey, she imagines the settlers heading west. You are not a pioneer if the road is paved. You are only a pioneer if you are paving the road, making your way through the brush. It is exhausting, but it also helps her understand some of the struggles she has faced. Recognizing her role as a pioneer brings her a bit of peace [8].

Franklin has received her fair share of awards, including the IEEE Walter Cox Award from the IEEE Microwave Theory and Techniques Society in 2019 for service "in a spirit of selfless dedication and cooperation." She was honored and humbled by the society's acknowledgment because she realized it meant that a lot of people had been watching her and recognizing her contribution. She understood it as a thank you from the field [8].

As Franklin looks back on more than two decades in the field, at both her struggles and her accomplishments, she has given some thought to how organizations recognize achievement and how diversity challenges that. A common phenomenon in organizations, including the IEEE, has recognition and acknowledgment often coming later in one's career, as it takes time to navigate the competitive landscape and reach higher levels. Franklin has observed this pattern in various other fields, such as music (Grammys) and film (Academy Awards), even when they showcase awards for "best new" or early career achievements.

Entwined with rewards for success is the dilemma of assimilation. Historically, efforts to diversify organizations have often centered around assimilating individuals into the existing system. This process tends to favor those who resemble the established norms and have the ability to navigate the filters and barriers in place. The first generation of women pioneers in microwaves were able to break through. However, to foster greater participation and inclusion, it's essential to embrace the idea that diverse participants may not conform entirely to the existing system. The goal should be to create an environment that accommodates different needs and perspectives [3].

In preparation for giving the faculty convocation address to incoming freshman at the University of Minnesota at the start of the 2021–22 academic year, Franklin had been giving thought to the nature of success. Fundamentally, she does not believe that people are successful. She argues, and admits that she is being picky with her vocabulary here, that people succeed at specific things. When she looks back on her career and her successes, she recognizes that when she first became a professor she wanted to be a strong intellectual contributor to the community and she wanted to help develop the next generation of engineers. She had ideas of what this would look like, but she did not have any benchmarks. Without any benchmarks, how could she tell if she were succeeding? How do you count if you have inspired or enabled people? The problem with being a professor is that it is a long race and it can take years before you find out if what you have been trying to do is working. It is only now that her former students are reaching back to reaffirm Franklin's methods. She has succeeded in helping shape the careers of many students [8].

Although there may be a significant number of participants in an organization as large as the IEEE or even MTT, reaching the finish line in terms of recognition and acknowledgment can still be challenging. Even if 1% of the group wins an award, because of the small number of women in the field, it will take a long time before there is a critical mass of women role models. To address this, it is crucial to increase the number of participants by creating an environment that caters to diverse needs and aspirations.

Franklin believes in naming a goal and then working towards it. Unfortunately, another challenge with rewards is that the process by which they are bestowed can be a mystery. For example, Franklin has become interested in being named an IEEE Fellow. Only recently has IEEE made the process more explicit and accessible by outlining the process online [18]. Furthermore, the IEEE now has a searchable database of fellows that potential nominees can review fellows in their field and read the citations that garnered the achievement. The Fellow Directory can also be filtered by affiliation, region, and gender, among others, and IEEE provides statistical fact sheets that show representation across these categories have changed over the years. By demystifying the process, IEEE has pulled back the curtains. Franklin has named her goal and is now working towards it [8].

Franklin suggests that how women approach their careers might parallel an approach to childcare. Just as a mother may seek small wins for her children, it's vital to provide opportunities for individuals to experience success and growth throughout their careers. Those who have faced constant barriers or lack of support may struggle to thrive. By exposing, encouraging, disciplining when necessary, and providing

training and coaching, the field as a whole can create an environment where individuals have the opportunity to excel. By doing so, the chances of identifying and acknowledging rising stars within the organization can improve [3].

VII. MORE ABOUT ORAL HISTORIES AND THIS SERIES

Rhonda Franklin was the fourth subject interviewed for this series, and the first that shows the generational legacy of early pioneering women – her advisor was Linda Katehi, the first engineer featured in the "Women in Engineering" series for the *Journal of Microwaves* [19]. If you want to nominate a female mentor, whether professor, advisor, or industry supporter, please contact me. Similarly, if you would like your story to be documented, all are welcome.

The stories I have heard so far are incredibly powerful. All women working in the field are pioneers, even if they don't consider themselves to be so. All women – from those just starting their graduate studies to those who have established careers – are defining the field, and I treasure all of the experiences you bring to the table.

One of the treasures of conducting oral histories (or reading or listening to them some time in the future) is that they capture aspects of the personality of the interviewee that tend to go unrecorded in published articles. For example, Rhonda Franklin speaks in beautiful metaphors. She described the tight-knit support community of her youth as a tapestry tablecloth consisting of family, friends, and helpful teachers. While she was an undergraduate, that tapestry became more like a lace runner, fundamentally smaller and more porous. Although it was a great piece of lace, it was more delicate than her tapestry [3]. By the time Franklin was in graduate school, that lace had shrunk to the size of a doily, sparse and limited [3].

Instead of falling into the cliché of "wearing many hats," Franklin compared challenges women face to wearing shoes. As they are looking to advance in their careers, they are trying on different shoes, but they may not be able to wear them as much as they want because they are required to wear so many other shoes just to get there [3]. Metaphors give character to people and the lives they live.

I am looking to make this as diverse a community as possible. That includes age, race, geographic location, field of work, and professional setting, among others. The Society of Women Engineers has collected over 75 oral histories [20], and numerous IEEE societies have collected oral histories of their members [21], but when we started this project there were only two oral histories of women in the field of microwaves previously recorded in the archive (and one of those we probably wouldn't really count). I would like to change this, but I need your help. Contact me with any questions or suggestions.

This project is being done in conjunction with the IEEE History Center. Following their procedures, both interviewer and interviewee sign a consent form. The interviewer also shares an outline and list of questions in advance of the interview. If the interviewee has any questions, they can be clarified during an optional pre-interview phone call or email. The interviews generally take about two hours, but can be longer or shorter depending on loquaciousness. The interviews can be completed in a single session or can be done over several shorter sessions.

After the interview is complete, the audio recordings are transcribed by a third party. The oral historian then lightly edits the transcription, removing filler words such as ums and ahs. She also inserts punctuation and imposes a paragraph structure on the narrative. As part of their oral history procedures, all interviewees have the opportunity to review the transcript of the interview and make necessary edits and corrections. In particular, the oral historian highlights names and dates to ensure their accuracy. At this point, interviewees have the option of redacting information that in retrospect they wish they had not said.

The audio/video recordings are permanently archived with the IEEE History Center, but they are not made available to the public or researchers unless there is a specific documented need. Only the written transcripts are posted on the Engineering and Technology History Wiki.

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REFERENCES

[1] S. Hess and R. Franklin, "Interview with the 2021 IMS women in microwaves event chair [Women in Microwaves]," *IEEE Microw. Mag.*, vol. 22, no. 5, pp. 27–30, May 2021, doi: 10.1109/MMM.2021.3056976.

[2] V. Palazzi, "3MT's positive impact: Personal and professional growth [women in microwaves]," *IEEE Microw. Mag.*, vol. 23, no. 3, pp. 80–82, Mar. 2022, doi: 10.1109/MMM.2021.3132195.

[3] R. Franklin, "Oral history, part 1, interview by Allison Marsh," Jul. 27, 2021, Interview #861 for the IEEE History Center.

[4] "Dr. ARCS. Rhonda Franklin presentation," Accessed: May 17, 2023. [Online]. Available: https://youtu.be/BkyJiaPANk4

[5] Accessed: May 17, 2023. [Online]. Available: https://howardgadamsasso.com/biosketch/

[6] L. Katehi, "Interview by Allison Marsh and Katherine Kuisel," Interview #849 for the IEEE History Center, Feb. 25 2021.

[7] K. Pattison, "Rhonda Franklin: Reaching out," Univ. Minnesota, College Sci. Eng. Accessed: May 19, 2023. [Online]. Available: https://web.archive.org/web/20190227005215/https://cse.umn.edu/college/feature-stories/rhonda-franklin-reaching-out

[8] R. Franklin, "Oral history, part 2, interview by Allison Marsh," Aug. 23, 2021, Interview #861 for the IEEE History Center.

[9] Accessed: May 18, 2023. [Online]. Available: https://cse.umn.edu/ece/rhonda-franklin

[10] R. F. Drayton, *The Development and Characterization of Self-Packages Using Micromachining Techniques for High Frequency Circuit Applications*. Ann Arbor, MI, USA: Univ. Michigan, 1995.

[11] F. T. Ulaby, "Overview of the University of Michigan space terahertz technology program," in *Proc. 1st Int. Symp. Space THz Technol.*, 1992, pp. 24–26.

[12] "Micromachined self packaged circuits for high-frequency applications," Mar. 1997. Accessed: May 19, 2023. [Online]. Available: https://patents.google.com/patent/US5608263A/en?oq=5%2c608%2c26

[13] Accessed: May 21, 2023. [Online]. Available: https://bondlab.umn.edu/great-people/daniel-bond
[14] Y. Liu, H. Kim, R. R. Franklin, and D. R. Bond, "Linking spectral and electrochemical analysis to monitor C-type cytochrome redox status in living Geobacter sulfurreducens biofilms," *ChemPhysChem*, vol. 12, pp. 2235–2241, 2011.
[15] Accessed: May 22, 2023. [Online]. Available: https://stadler.umn.edu/people/beth-stadler
[16] "Beth Stadler: Nanoheaters for electronics and organ donation," Accessed: May 22, 2023. [Online]. Available: https://research.umn.edu/units/techcomm/news/beth-stadler-nanoheaters-electronics-and-organ-donation
[17] Accessed: May 22, 2023. [Online]. Available: https://profiles.utdallas.edu/rashaunda.henderson
[18] Accessed: May 21, 2023. [Online]. Available: https://www.ieee.org/membership/fellows/steps.html
[19] A. Marsh and K. Kuisel, "Women in Microwaves: Linda Katehi," *IEEE J. Microwaves*, vol. 1, no. 3, pp. 689–697, Jul. 2021.
[20] Accessed: May 4, 2021. [Online]. Available: https://ethw.org/Oral-History:Society_of_Women_Engineers_Oral_Histories
[21] Accessed: May 4, 2021. [Online]. Available: https://ethw.org/Oral-History:List_of_all_Oral_Histories

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