MAE 584

Spring 2024

CPT Internship Report

Rayn Innovation, LLC

(R&D Intern)

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Master of Science (MS) in Mechanical Engineering

ACKNOWLEDGEMENT

I am immensely grateful for the invaluable opportunity to serve as an R&D Intern at Rayn Innovation, a pioneering startup company founded by Dr. Nicole Ray in 2015 as an Arizona State University spin-off. This internship has been a transformative experience, allowing me to contribute to the cutting-edge research and development of tunable thin films for integrated circuits, antennas, RF, EMI devices, and more while gaining practical insights into the dynamic world of materials science and engineering.

I extend my heartfelt appreciation to Nicole, the visionary CEO, for her exemplary leadership and unwavering support throughout this internship. Her guidance and mentorship have been instrumental in shaping my understanding of the industry and fostering my professional growth. I am truly grateful for the opportunity to work closely with Alex, my manager, whose wealth of knowledge and expertise in novel research, experimental design, thin film production, characterization, and research funding proposal writing have been invaluable. His patience, attention to detail, and commitment to excellence have inspired me to push beyond my limits and strive for continuous improvement.

During my internship, I had the privilege of working on spin coating experiments, contributing to the development of aluminum-doped zinc oxide (AZO) as a promising material for photovoltaic (PV) thin films and transparent conductive oxide (TCO) applications. The hands-on experience and practical exposure have deepened my understanding of the challenges and opportunities in this field, fueling my enthusiasm for further exploration and innovation.

Furthermore, attending the prestigious MRS Spring 2024 Exhibit in Seattle has been a highlight of my internship. Interacting with leading researchers, industry experts, and potential collaborators has broadened my horizons and provided me with valuable insights into the latest advancements and industry perspectives in materials science, particularly in the space and defense sectors.

I am grateful to Rayn Innovation for entrusting me with this incredible opportunity and for fostering an environment that encourages growth, innovation, and excellence. This internship has solidified my commitment to pursuing a career in materials science and engineering, where I can contribute to the development of sustainable and cutting-edge solutions that shape the future of various industries, including space and defense.

With a profound sense of gratitude and a renewed passion for learning, I eagerly anticipate applying the knowledge and experiences gained during this internship to future endeavors, continuing my journey of personal and professional growth in the dynamic field of materials science and engineering.

Sincerely,

Varad Lad

SUMMARY

This comprehensive internship report details my immersive and transformative experience as an R&D Intern at Rayn Innovation, a pioneering startup company in the field of materials science and engineering. The report spans my internship period, during which I had the privilege of contributing to the cutting-edge research and development of tunable thin films for various applications, including integrated circuits, antennas, RF, EMI devices, and more.

The report provides an in-depth introduction to Rayn Innovation, its founding by Dr. Nicole Ray as an Arizona State University spin-off, and its focus on developing innovative solutions through the exploration of ferrite and alloy-based thin films using low-temperature aqueous deposition and electrodeposition processes.

My internship journey is meticulously documented, highlighting my involvement in spin coating experiments and the development of aluminum-doped zinc oxide (AZO) as a promising material for photovoltaic (PV) thin films and transparent conductive oxide (TCO) applications. The report underscores the hands-on experience I gained, the challenges I overcame, and the invaluable insights I acquired into the dynamic field of materials science and engineering.

Moreover, the report encompasses my attendance at the prestigious MRS Spring 2024 Exhibit in Seattle, where I had the opportunity to interact with leading researchers, industry experts, and potential collaborators. This experience broadened my horizons and provided me with valuable insights into the latest advancements and industry perspectives, particularly in the space and defense sectors, where Rayn Innovation's solutions hold significant potential.

The report also includes a glowing recommendation from my manager, Alex, highlighting my exceptional performance, dedication, and contributions to the research and development efforts at Rayn Innovation. It emphasizes my technical proficiency, ability to learn and adapt quickly, and commitment to excellence, underscoring my readiness to contribute positively to any project or team within the realm of materials science and engineering.

In conclusion, my internship at Rayn Innovation has been a transformative journey, equipping me with practical skills, industry knowledge, and a deeper understanding of the dynamic world of materials science and engineering. This report serves as a testament to my growth, accomplishments, and unwavering passion for innovation in this field, setting the stage for future endeavors and contributions to the development of cutting-edge solutions that shape the future.

ABOUT RAYN INNOVATION

Industry: Space and Defense, Material Science and Research

Headquarters: Tempe, Arizona

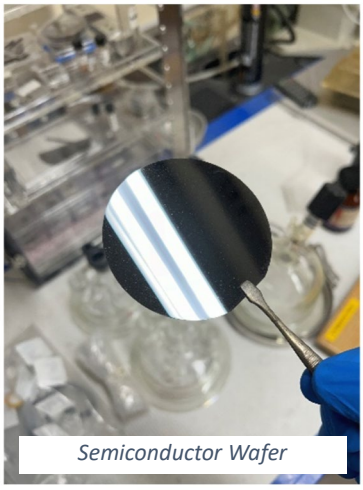
Founded: 2015

Specialties: Thin Film Deposition, Semiconductors, Tunable Materials, Integrated Circuits, Antennas, RF Devices, EMI Shielding, Consulting, R&D Services

Rayn Innovation was founded in 2015 as an Arizona State University spin-off company by Dr. Nicole Ray. The company is at the forefront of materials science and engineering, specializing in the development of tunable thin films for a wide range of applications, including integrated circuits, antennas, RF devices, and EMI shielding. With its headquarters in Tempe, Arizona, Rayn Innovation offers a comprehensive suite of services, including consulting, research and development, and product development.

The heart of the company's business lies in the research and development of ferrite and alloy-based thin films, leveraging multiple deposition processes, such as aqueous deposition and electrodeposition. Rayn Innovation's expertise lies in low-temperature thin film deposition techniques, enabling the integration of components onto plastic substrates. This unique capability opens up new avenues for innovation and enables the development of cutting-edge solutions across various industries, including space and defense. The company's commitment to excellence and innovation is further reinforced by its focus on continuous research and development. By exploring novel materials and deposition techniques, Rayn Innovation aims to push the boundaries of what is possible in the field of materials science and engineering, driving advancements in areas such as photovoltaic (PV) thin films, transparent conductive oxides (TCOs), and more. Rayn Innovation's success is built upon a foundation of collaboration, fostering partnerships with academic institutions, research facilities, and industry leaders. These collaborations facilitate knowledge sharing, resource pooling, and the seamless integration of cutting-edge research into practical applications, positioning the company as a trailblazer in the materials science and engineering landscape.

Spin Coating Deposition



Semiconductor Wafer

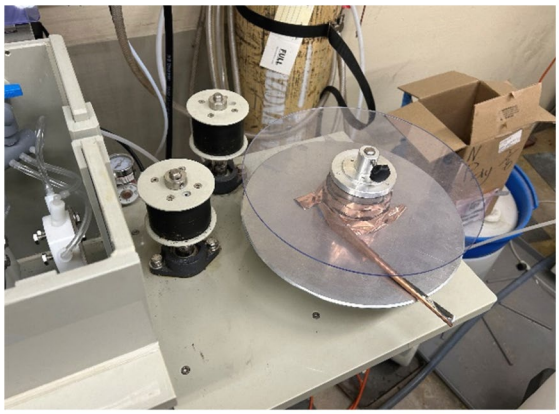
PROJECT

During my time as a Process Engineer in Research and Development at Rayn Innovation, I was entrusted with several critical responsibilities that allowed me to contribute to the company's cutting-edge work in thin-film deposition techniques and materials research. One of my key achievements was the invention and execution of a cost-effective and environmentally friendly hybrid chemical bath deposition (CBD) and spin-coating technique for thin-film deposition. This innovative approach replaced commonly used methods like PEALD, PVD, and CVD, leading to a 4% faster deposition rate, demonstrating my ability to develop efficient and sustainable manufacturing processes.

Furthermore, I played a pivotal role in the successful NSF project proposal by researching aluminum-doped zinc oxide (AZO) as an alternative thin-film material for photovoltaic (PV) devices. My research aimed to overcome the limitations of traditional materials, showcasing my expertise in identifying and exploring innovative solutions. To ensure the production of high-quality thin films, I executed comprehensive characterization methods, including SEM, TEM, EDX, XRD, and UV-Vis, to improve thin-film uniformity.

In addition to my technical contributions, I demonstrated a strong command of statistical and process optimization techniques. By applying Design of Experiments (DOE) principles, I was able to optimize the deposition process, resulting in an 8% improvement in film quality and a 20% reduction in defects and waste. My commitment to continuous improvement was further exemplified through my electrodeposition experiments, where I achieved a 6% improvement in uniform coating on copper film substrates.

Through this internship, I gained invaluable hands-on experience in developing and optimizing thin-film deposition techniques, with a particular focus on environmentally friendly and cost-effective methods. I acquired knowledge and practical skills in working with alternative thin-film materials, such as AZO, for photovoltaic and other applications. Additionally, I developed proficiency in various thin-film characterization techniques, including SEM, TEM, EDX, XRD, and UV-Vis, enabling me to conduct comprehensive analyses and ensure high-quality film production.



Copper Film

Learnings: I learned to apply statistical techniques like the Design of Experiments (DOE) to optimize complex manufacturing processes and improve product quality. This experience strengthened my skills in conducting experiments, data analysis, and problem-solving in a research and development environment. Furthermore, I gained exposure to the process of writing and contributing to research proposals, such as the successful NSF project proposal, further enhancing my understanding of the research and development landscape.

In conclusion, this internship provided me with a comprehensive and immersive learning experience, allowing me to contribute to cutting-edge research and development efforts while acquiring valuable skills in thin-film deposition techniques, materials research, process optimization, and working in an innovative and collaborative research setting focused on sustainable manufacturing processes and advanced materials. I am grateful for the opportunity to work with Rayn Innovation and look forward to applying the knowledge and experiences gained during this internship to future endeavors in the field of materials science and engineering.

Electro-deposition Machine

CONCLUSION

To sum up, I would say that working as an intern at Rayn Innovation has been a rewarding and life-changing experience that has greatly aided in my development on both a personal and professional level. During my time working as an R&D intern, I have learned a great deal about the dynamic fields of thin film deposition and semiconductor production, and I have also developed a wide range of useful skills and knowledge.

One of the best parts of my internship experience has been working on the Thin Film Project. Through this project, I've been able to highlight my technical proficiency, work well with a varied team, and exhibit my unwavering dedication to excellence. I've developed a thorough grasp of project engineering in the Material Science field, from carefully following industry laws to helping with budgeting, time management, and design.

In addition, my creative contributions demonstrate my dedication to pushing the limits of efficacy and efficiency. This is especially evident in my work with spin coating devices, where I have solved numerous issues to increase deposition and data accuracy.

I'm excited to use the skills and information I picked up during my internship to help future Material Research and Engineering projects and organizations as I go on to the next chapter of my career.