BS in Chemistry
BS in Biochemistry

Jefferson College of Life Sciences

Jefferson
Thomas Jefferson University

Dr. Niny Rao

DEPARTMENT OF BIOLOGICAL AND CHEMICAL SCIENCES
CHEMISTRY/BIOCHEMISTRY PROGRAM DIRECTOR

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College of Life Sciences

Chemistry

This active and collaborative program will prepare you for what's next.

You start collecting chemical knowledge and skills through core courses and shadowing faculty and upper-level student researchers. As a sophomore, you will start helping with authentic, real-world research projects — experience many chemistry students don't get until graduate programs. This is possible thanks to the individual attention you get in our small classes and our well-equipped research laboratories.

HIGHLIGHTS

- Small classes with one-on-one faculty guidance
- Intensive, real-world research experience
- Unique, faculty-designed experiments
- Experience presenting before scientific community
- Access to top internships, nationwide
- Preparation for graduate school or careers in the non-profit, industrial, governmental, or medical realms.

Jefferson | CREATE WHAT'S NEXT

College of Life Sciences

Biochemistry

You will be a sought-after candidate for scientific careers or graduate programs, thanks to professional research experience, and close faculty mentorship.

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- Unique, faculty-designed experiments
- Experience presenting before scientific community
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Chemistry Program Curriculum

YEAR ONE

CORE CURRICULUM
- Calculus I and II
- Chemistry I and II Lecture and Lab
- Biology I and II Lecture and Lab

YEAR TWO

CORE CURRICULUM
- Mathematical Methods
- Physics I Lecture and Lab
- Physics II Lecture and Lab
- Organic Chemistry I Lecture and Lab
- Organic Chemistry II Lecture and Lab

YEAR THREE

CORE CURRICULUM
- Biochemistry I Lecture and Lab
- Biochemistry II Lecture and Lab
- Physical Chemistry I (Fall)
- Physical Chemistry II (Spring)

YEAR FOUR

CORE CURRICULUM
- Instrumental Methods Analysis (Fall)
- Inorganic Chemistry (Spring)

ADVANCED CHEMISTRY ELECTIVES
- 5 Electives (15-16 credits)

ADDITIONAL ELECTIVES
- **4 Free Electives (12 credits)**

TOTAL CREDIT HOURS: 124-125

This program is approved by the ACS (American Chemical Society)

Biochemistry Program Curriculum

YEAR ONE

CORE CURRICULUM
- Calculus I and II
- Chemistry I and II Lecture and Lab
- Biology I and II Lecture and Lab

YEAR TWO

CORE CURRICULUM
- Mathematical Methods
- Physics I Lecture and Lab
- Physics II Lecture and Lab
- Organic Chemistry I Lecture and Lab
- Organic Chemistry II Lecture and Lab

YEAR THREE

CORE CURRICULUM
- Biochemistry I Lecture and Lab
- Biochemistry II Lecture and Lab
- Physical Chemistry I (Fall)
- Physical Chemistry II (Spring)

YEAR FOUR

CORE CURRICULUM
- Instrumental Methods Analysis (Fall)
- Inorganic Chemistry (Spring)

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- 5 Electives (15-16 credits)

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Green Synthesis of Silver Nanoparticles Using Lab Waste-Products

Madisyn Peoples and Dr. Brian Yust

Department of Biological and Chemical Sciences, College of Life Sciences, Thomas Jefferson University

INTRODUCTION

- Metallic nanoparticles are typically synthesized using techniques that utilize toxic chemicals, which makes these synthesis methods less environmentally friendly and more expensive.
- In order to avoid unnecessary exposure to toxic chemicals and reduce harmful waste, green synthesis methods are becoming more and more popular in the field of nanotechnology, as well as other branches of physical sciences.
- This research takes into consideration the importance of green synthesis, while developing a synthesis method that can produce little to no harmful waste by using lab waste-products from a food chemistry research lab.

EXPERIMENTAL METHODS

Coffee Grounds:

30 mL DI water + 0.3 g coffee grounds + 50 mg silver nitrate

stir for 2 hours at constant temperature (55°C)

Spent Coffee:

30 mL DI water + spent coffee (varying amounts) + 50 mg silver nitrate

stir for 2 hours at constant temperature (55°C)

Conventional Synthesis Standard:

DI water + silver nitrate + sodium citrate + sodium borohydride + L-cysteine

stir for 30 mins on ice

Note: Cerium oxide nanoparticles were synthesized using standard wet-bench synthesis.

Characterization:

The synthesized particles were characterized using UV-Vis Spectroscopy. This method of characterization can not only measure the optical properties, but the spectra can be used to infer the relative size and shape of the particles. To characterize the particles synthesized during the coffee trials, standard particles were also studied as a basis for comparison for varying properties of the particles. It is important to note that the spectra of cerium oxide nanoparticles is not directly correlated to size and shape of the particles, while the spectra of silver nanoparticles can be directly correlated to these characteristics due to surface plasmon resonance.

EXPERIMENTAL DATA

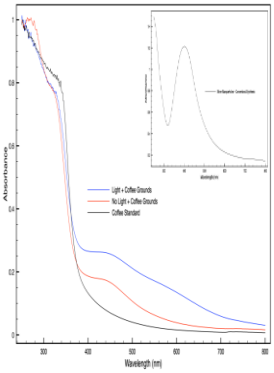


Figure 1. UV-Vis spectra of silver nanoparticles synthesized in various light conditions using coffee grounds; inset: a UV-Vis spectra of conventionally synthesized standard silver particles.

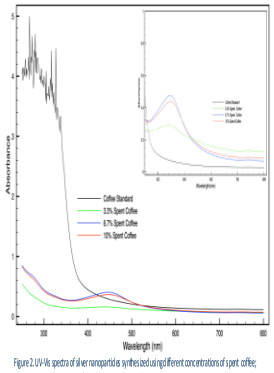


Figure 2. UV-Vis spectra of silver nanoparticles synthesized using different concentrations of spent coffee; inset: is a zoomed-in spectra of the peak at approximately 450 nm.

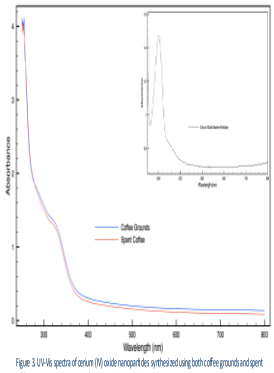


Figure 3. UV-Vis spectra of cerium (IV) oxide nanoparticles synthesized using both coffee grounds and spent coffee; inset: is UV-Vis spectra of cerium oxide standard particles.

RESULTS

- Figure 1 shows that the amount of nanoparticles synthesized with coffee grounds was impacted by the light conditions of the synthesis; the shape of the peaks (slight double-hump near 600 nm) indicates that the particles have a rod-like shape.
- The presence of light had an impact on the particles synthesized in the presence of coffee grounds but did not have an impact on the spent coffee synthesis.
- Figure 2 indicates that the different concentration of spent coffee has an impact on the concentration of nanoparticles synthesized, but not on their size or shape.
- Figure 3 demonstrates that coffee has an impact on the particles synthesized by a cerium oxide wet-bench synthesis; the slight peak near 300 nm is indicative of cerium nanoparticles in the 4+ state (Pulido-Reyes et al., 2015).

CONCLUSIONS

- Results demonstrate the suitability of food chemistry waste as a sustainable replacement for typical reducing agents which may be harsh or toxic to the environment.
- Varying concentration or type of coffee utilized in the synthesis as the reducing agent, whether it be coffee grounds or liquid coffee, influences the size/shape of the particles, therefore impacting the functionality of the particles.
- The particles synthesized using the green method are comparable to the particles using the standard sodium borohydride wet-bench synthesis.

FUTURE WORK

The silver nanoparticles synthesized in this project can have further applications in manufacturing anti-microbial textiles, having both clothing and healthcare applications. Further testing such as x-ray diffraction or electron microscopy can be conducted to more closely examine the size/shape of the particles.

REFERENCES & ACKNOWLEDGMENTS

References:

Chen, H., Xue, C., Xiao, L., Lin, G., & Chen, P. (2019). Polysaccharide spent coffee grounds for silver nanoparticle immobilization as a green and highly efficient biocide. *International Journal of Biological Macromolecules, 140*, 168-176. https://doi.org/10.1016/j.ijbiomac.2019.08.151

Gerardo Pulido-Reyes, Ismael Rodea-Palomares, Soumen Das, Tamil Selvan Sakthivel, Francisco Leganes, Roberto Rosal, ... Francisca Fernández-Piñas. (2015). Untangling the biological effects of cerium oxide nanoparticles: the role of surface valence states. *Scientific Reports, 5*(1), 156 13. https://doi.org/10.1038/srep15613

Lukas Cardeña, & Marta Elena Londoño. (2016). Green synthesis of silver nanoparticles using green coffee bean extract. https://doi.org/10.13140/RG.2.2.17795.71207

This project received support from the Coffee Research Lab at Thomas Jefferson University led by Dr. Nimy Rao.

Sample student work: Presented at the National Conference of Undergraduate Research

CREATE WHAT'S NEXT

Jefferson

OUTCOMES

GRADUATION RATE

100%

PLACEMENT RATE

100%

AWARDS

- American Chemical Society Analytical Chemistry Award
- American Chemical Society Undergraduate Award

EXAMPLES OF EMPLOYERS OF JEFFERSON GRADUATES

- Dunmore
- FMC
- Dow Chemical
- GlaxoSmithKline

CAREERS

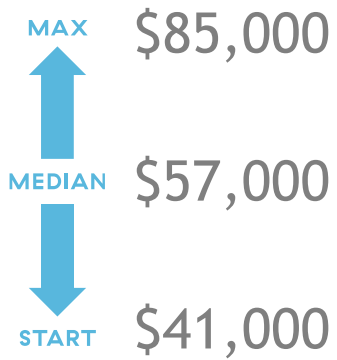
JOB TITLE

Chemist (Entry Level)

OUTLOOK

- These positions can be in quality assurance, product development, research, and data analysis.
- Typical tasks include maintain, troubleshoot, and use various instruments, equipment, and software tools utilized for chemical analysis and processing.
- Strong data interpretation and analytical skills are required, as often times chemists are responsible for interpreting and analyzing data and equipment logs from other laboratory members.
- Chemists need to accurately report and track ingredient yields, quality measures, and occasionally microbiological results in addition to other key data sets such as quality assurance test data, including testing formulations, substrates, and reagents.
- Chemists also must be very attentive to detail, especially since certain analytical tasks may be completely ruined with the slightest error.
- When necessary, the chemist must show an aptitude for experimental design. Additionally, chemists collect and document.

SALARIES



- American Chemical Society
  - Founded in 1876 and chartered by the U.S. Congress, ACS is one of the world's largest scientific organizations with more than 155,000 members in 130+ countries. Their goal is to advance the broader chemistry enterprise and its practitioners for the benefit of Earth and its people.
  - Members of ACS are empowered to advance chemistry, elevate their career potential, expand their networks, collaborate globally, and build communities that provide scientific solutions.

STUDENT PROFILE

Millie Coombes

ISLE OF WIGHT, UK
CLASS OF 2021

I was first recruited to Jefferson as part of the Women's Tennis team and it's the best decision I've ever made. As someone who wishes to go into research in the future the fact that there are so many opportunities for undergraduates to engage in research was a real draw to me.

"You don't know until you try."

Choosing colleges can be tough, but always go with your gut instinct. If you're looking for innovation and opportunity here's the place to be.

STUDENT PROFILE

Morgan Robinson

Swedesboro, NJ
Women's Basketball
CLASS OF 2023

I chose Jefferson because of the family atmosphere. The entire community is welcoming and accepting. This is the place where I want to mature and evolve as a person. There's nowhere else I'd rather be!

"Don't take anything for granted! Experience the college life to the fullest because you never know when it can be taken away."

Always ask questions! Try new things! And have fun!

FACULTY PROFILE

Dr. Niny Rao

DEPARTMENT OF CHEMISTRY, ASSOCIATE PROFESSOR

B.Eng. In Chemical Engineering From The Cooper Union
Ph.D In Physical Chemistry From Florida State University

A computational chemist by training, Dr. Rao has recently expanded her research into the field of food science, such as chemistry of cold brew coffee. Her research has been covered by numerous news outlets such as the Popular Mechanics and the Huffington Post.

COURSES

- CHEM-103/104 – Chemistry I and II
- CHEM-305/306 – Physical Chemistry I and II
- SCI-402 – Science Seminar
- COMP-101 – Coding for Beginners

FACULTY PROFILE

Dr. Jeffrey Ashley

DEPARTMENT OF CHEMISTRY, PROFESSOR

B.S. CHEMISTRY FROM CARLETON UNIVERSITY
M.S. CHEMISTRY FROM QUEEN'S UNIVERSITY
M.S. MARINE CHEMISTRY FROM FLORIDA TECH
Ph.D. MARINE, ESTAURINE, AND ENVIRONMENTAL SCIENCES FROM UNIVERSITY OF MARYLAND AT COLLEGE PARK

Dr. Ashley has taught for over two decades and was awarded a Lindback Teaching Excellence Award in 2012 and the SCUP Fellowship in 2018-19 for research on the intersection of learning space and pedagogy. He is well-published in his discipline of the fate, transport and accumulation on human-made contaminants.

COURSES

- CHEM103/104/103L/104L Chemistry I and II Lecture and Lab
- CHEM321 Instrumental Methods of Analysis
- BIOL319 Oceanography

FACULTY PROFILE

Dr. John Milligan

DEPARTMENT OF CHEMICAL AND BIOLOGICAL SCENCES, ASSISTANT PROFESSOR

B.S. IN CHEMISTRY FROM ALLEGHENY COLLEGE
Ph.D. IN CHEMISTRY FROM THE UNIVERSITY OF PITTSBURGH
POST-DOCTORAL TRAINING AT THE UNIVERSITY OF PENNSYLVANIA

Dr. Milligan's expertise is organic chemistry. Aside from teaching organic chemistry courses, his research involves using blue LED light as a driving force for electron transfer to build organic molecules.

COURSES

- CHEM 201/201L – ORGANIC CHEMISTRY 1 AND LAB
- CHEM 202/202L – ORGANIC CHEMISTRY 2 AND LAB
- CHEM 405 – ADVANCED ORGANIC

FACULTY PROFILE

Dr. Stephen Podowitz-Thomas

DEPARTMENT OF CHEMICAL AND BIOLOGICAL SCENCES,
ASSISTANT PROFESSOR

B.S. IN MATERIALS SCIENCE FROM COLUMBIA UNIVERSITY
Ph.D. IN MATERIALS SCIENCE FROM STANFORD UNIVERSITY
POST-DOCTORAL TRAINING AT THE ANALYTICAL INSTRUMENTATION FACILITY, NC STATE UNIVERSITY

Dr. Podowitz-Thomas's research is in the areas of materials chemistry and chemical education. His research focuses on developing novel solid-state, inorganic materials for more environmental-friendly technology, such as LED lighting. His chemical education research focuses on the impact of instructional practices (including active learning and team-based learning) on undergraduate students from underrepresented communities in STEM.

COURSES

- CHEM 103/103L – CHEMISTRY I AND LAB
- CHEM 104 – CHEMISTRY II

FACULTY PROFILE

Dr. Marlena Washington

DEPARTMENT OF CHEMISTRY, ASSISTANT PROFESSOR

B.S. IN BIOLOGY FROM JOHN CARROLL UNIVERSITY
Ph.D. IN CHEMISTRY FROM CASE WESTERN RESERVE UNIVERSITY
POST-DOCTORAL FELLOWSHIP AT INDIANA UNIVERSITY

Dr. Washington's expertise is main group inorganic chemistry. Aside from teaching chemistry, her research focuses on the synthesis of heterocyclic compounds with applications in more energetically favorable opto-electronic materials and remediation studies.

COURSES

- CHEM 201/201L – Organic Chemistry I Lecture and Lab
- CHEM 202/202L – Organic Chemistry II Lecture and Lab
- CHEM 309 – Inorganic Chemistry Lecture and Lab

FACULTY PROFILE

Dr. Kyle Wagner

DEPARTMENT OF CHEMISTRY, Assistant Professor

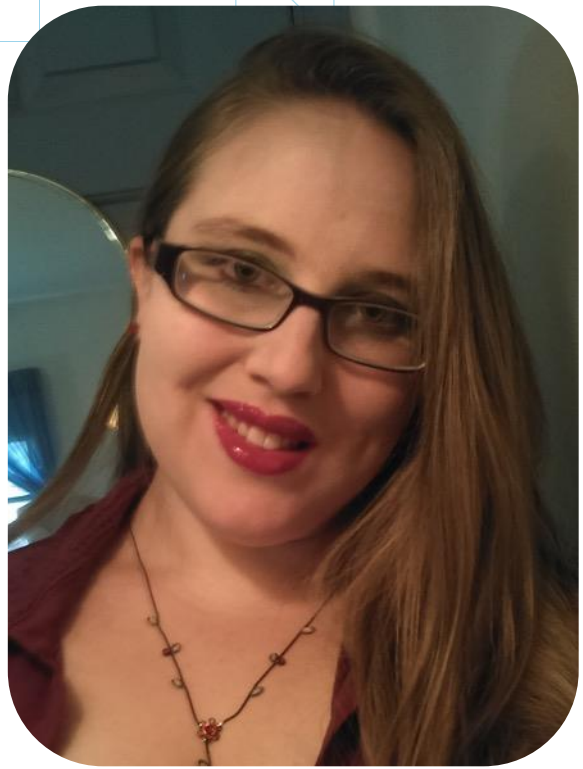
B.S. IN CHEMISTRY FROM KUTZTOWN UNIVERSITY
Ph.D FROM LEHIGH UNIVERSITY

Dr. Wagner's expertise is in physical chemistry. His research focuses on the interactions formed between nanomaterials and DNA.

COURSES

- CHEM-103 – GENERAL CHEMISTRY I
- CHEM-104 – GENERAL CHEMISTRY II
- CHEM-306 – PHSYICAL CHEMISTRY II

FACULTY PROFILE



Dr. Gwendolyn E. Moise

DEPARTMENT OF CHEMISTRY, TEACHING ASSISTANT PROFESSOR

B.S. BIOLOGY FROM CHATHAM UNIVERCITY
Ph.D. IN ORGANIC CHMISTRY FROM UTAH STATE UNIVERCITY

Dr. Moise is a Teaching Assistant Professor and was the general chemistry laboratory coordinator.

COURSES

- CHEM 103/103L Chemistry I and lab
- CHEM 104/104L Chemistry II and lab
- CHEM 201L Organic Chemistry I Lab
- CHEM 202L Organic Chemistry II Lab

ALUMNI PROFILE

Nina Morvin

Genetic Counselor, Penn Medicine- Lancaster General Health
Willow Grove, PA (hometown)
West Chester, PA (current)
CLASS OF 2016

Nina will begin her career as a genetic counselor in May 2021 upon graduating with her Masters in Human Genetics and Genetic Counseling from Thomas Jefferson University. Jefferson provided Nina with experiences routed in science and strong sense of community that has guided her to find her passion in utilizing genetic concepts to help others make informed decisions about their health care.

"My time at Philadelphia University, now Jefferson, was filled with countless encounters that deepened my love for science and particularly genetics as well as emphasized the importance of community and building relationships with others."

Nina believes that getting involved and trying new things can provide one with unforeseen experiences that lead to a better understanding of self and one's purpose in life.

ALUMNI PROFILE

Sajen P. Solberg

Flow Cytometry Specialist, Wuxi App Tec
Philadelphia, PA
Philadelphia, PA
CLASS OF 2015

I originally chose Jefferson due to the small campus and the close-knit college community. This helped immensely when it came to interacting with my undergraduate professors, allowing me to have a more personal relationships with my professors and allowed me to have reliable sources if I ever had trouble in my classes. By going to Jefferson, I was able to grasp a firm understanding of the basics of Biochemistry which allowed me to progress through my graduate education with relative ease. The knowledge I gained through classes at Jefferson allowed me to form strong habits in scientific technique and fundamental understandings that led me not only to a job immediately after college but helped pave a way to my future career.

My advice to future students is persevere and don't be too afraid of failure. It takes time to find the courses that are best for you. It takes time to find a job that can lead to a career. Even if you fail, that doesn't mean that it's over. There are many ways to get where you want to go, but it takes commitment to the task, acceptance of your faults, and personal motivation. Don't let your failures be an obstacle, learn from them and overcome them.

Jefferson

Thomas Jefferson University