

SUMMER SCHOLARS PROJECTS

PROJECT CATEGORY: Engineering & Technology

STARTUP: Chang Industrial

WEBSITE:

PROJECT TITLE: Graphene Oxide as a Sustainable Food Packaging Material

PROJECT DESCRIPTION

Plastics and per- and poly-fluoroalkyl substances (PFAS) are widely used in food and beverage packaging. While they are low-cost, effective barriers for liquids, grease, and gases critical for food safety and quality, they are a threat to both environment and human health. The EPA reported that in 2018 ~15M tons of plastics were used in the US for food, beverage, and pharmaceutical packaging. Two-thirds of that ended up in landfills. And in a recent study, almost a third of food packages tested had over 20 ppm of PFAS. In addition to health concerns, PFAS in paper packaging makes recycling impossible.

Societal pressure and governmental regulations are now leading to discontinued use of both PFAS and plastic. But there are presently, no equivalent, broadly available, low-cost, safe, sustainable replacements. The novel concept behind this application is the use of graphene oxide (GO) as a multifunctional material for food and beverage packaging. Specifically, when distributed as a thin, non-contiguous monolayer (i.e., GO sheets are non-overlapping at the nanoscale) on a paper substrate, GO can be used as a low-cost, safe, sustainable replacement for plastics and PFAS in food and beverage packaging. It has been shown that coating paper with very small amounts of GO (having a moderate C/O ratio of 1.5), followed by heating, provides significant improvements in water, oil/grease, and gas barrier properties to paper, thereby assuming key functionalities of plastics and PFAS. In addition, because GO is used in a small amount and has C/O ratios that are quite close to that of paper fibers, the GO-coated papers should be fully recyclable.

The aim of this work is producing low-cost formulations of graphene-oxide coatings for use in paper-based food and beverage packaging. The technical challenges lie in creating specific oxygenate functionalities, e.g., C/O ratios and/or particle size dispersions, to achieve specific barriers for water and oil/grease. The key point is that GO is not used here as a filler; rather this approach capitalizes on the electrostatic/chemical interactions of GO with the paper substrate and package contents. As such, very little GO is needed, but it is critical to get the underlying science and engineering right for maximum effect and minimum cost.

JOB EXPECTATIONS:

This opportunity includes the design and execution of experiments to optimize various material properties including concentration, temperature, and time, as well as application methodologies. The selected individual will be invited to engage in strategic discussions regarding the strategy and roadmap necessary for bringing the material to market in a safe, effective and timely way. Principal responsibilities include:

- Engage with the team to design an R&D strategy.
- Conduct experiments to optimize material performance.
- Keep detailed records of protocols, experiments, results, and analysis
- Present results and provide recommendations for future experiments to company leadership

DESIRED EXPERIENCE:

While experience working in chemistry laboratories and research is a plus, the greatest assets for this project are an interest and passion for the project, and the ability to connect tactical steps with the broader vision and goals. Specific requirements include:

- Currently enrolled as an undergraduate
- Some laboratory skills and experience with handling of chemicals
- Strong analytical and problem-solving skills
- Strong written and verbal communications skills

TIME COMMITMENT:

This opportunity requires the equivalent of a full time commitment of eight weeks. Flexibility in dates and hours can be accommodated.

TRAINING MENTORING:

Initial Meeting:

- Discuss the project goals and objectives, as well as the expectations for the internship.
- Project overview, including relevant background information, literature review, and experimental protocols.
- Training for safety and use of relevant equipment.

Weekly Meetings:

- The supervisor will be available as needed. However, in addition, weekly meetings will be held to discuss progress, any challenges encountered, and next steps.
- Supervisor will work with the intern to assess progress against overall product development goals and timelines.

Data Analysis and Interpretation:

- Supervisor will help intern learn and apply data analysis and statistical methods to interpret results.

Final Report and Presentation:

- The intern will be prepare a final report and give a final presentation to company leadership.
- The intern and supervisor will hold an exit meeting to debrief on the experience and value to both the intern and the company.