

SUMMER SCHOLARS PROJECTS

PROJECT CATEGORY: Materials & Industrial Processes

STARTUP: Actinia Inc

WEBSITE: <https://actiniadetectors.com/>

PROJECT TITLE: Optimization of Chemical Doping and Crystal Orientation to Improve the Radiation Detection Properties of Perovskites

PROJECT DESCRIPTION

Actinia's mission is to increase the resolution and decrease the dose used in radiological imaging techniques such as SPECT, CT, and even plain X-rays. Actinia develops cutting-edge radiation detector materials that allow for a halving of the dose, or doubling of the resolution, of common imaging techniques used in medicine and security. This project aims to provide answers to two questions about our materials. First, what is the optimal level (and identity) of dopant to add prior to crystallization? Second, what, if any, effect does crystal orientation have on the detector properties of perovskite crystals?

JOB EXPECTATIONS:

The student's role in this project will be to work closely with Actinia's Senior Scientists to synthesize starting materials; grow, cut, and polish crystals; and fabricate and characterize simple radiation detectors. Specific responsibilities will include:

- synthesis, purification, and doping of perovskite starting materials
- cutting, polishing, and characterization (e.g., by time-resolved photoluminescence) of large perovskite crystals
- fabrication and testing of radiation detection devices from crystal samples, particularly current-voltage tests

DESIRED EXPERIENCE:

We seek a student who is interested in materials science, chemistry, chemical engineering, or solid-state physics. An understanding of basic inorganic chemistry is desirable, and an understanding of semiconductor physics would be valuable, as well. In addition, experience working with chemicals in a laboratory environment would be helpful.

TIME COMMITMENT:

This will be a full-time internship, lasting 8 weeks, during the summer. We are flexible on the specific starting and ending dates. On most weeks, the student intern should expect to work a standard schedule, but the exact hours will vary depending on experimental requirements.

TRAINING MENTORING:

The student intern will primarily be mentored by Grant Alexander, PhD, a chemist and materials scientist. Additional mentoring will be provided by Josh Palmer, PhD, a trained chemist who is the CEO of the company. The student should also expect to have some facetime with Professor Mercuri Kanatzidis, one of the company's co-founders.

The training and mentoring plan can be divided into 3 phases, as described below:

1) Before the project: The intern will meet with both Dr. Alexander and Dr. Palmer to discuss the project's goals and the intern's responsibilities, as well as to go over safety information, notetaking procedures, and other important policies. The intern will also be given a tour of the facility, a lab notebook, PPE, etc.

2) During the project: The intern will participate in weekly group meetings that cover company progress with a focus on technical developments. In addition, the intern will have a weekly meeting with Dr. Alexander to discuss progress on the project described above. The intern will be trained, throughout the project, on the following techniques (and possibly others, as time permits):

- good laboratory practice and chemical hygiene
- chemical synthesis
- solid-state crystal growth
- X-ray diffraction
- use of wire saws and polishing equipment for processing brittle materials
- photoluminescence measurements (steady-state and time-resolved)
- sputtering and related techniques for metal deposition
- measurement of current-voltage relationships in semiconductor devices
- measurement of gamma-ray spectra

3) After the project: The intern will give a presentation to the team, including the CEO and at least one of the co-founders of the company, and detailed feedback will be provided.

Throughout the project period, feedback and training will be provided in the form of both informal exchanges in the laboratory and formal weekly meetings. In addition to the specific technical trainings listed above, the intern will be trained on proper data management, scientific notetaking, and best practices for presenting results. Time permitting, and if the intern is interested, there may also be opportunities to participate in the "business side" of the company, in the sense of discussing customer needs and how they map onto technical specifications.