

Faculty of Engineering

Summer Research Program 2024-2025

Project Title: **Solar Cell Research: Accelerated Materials Discovery Through Automation and AI**

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Objective

This project aims to address the growing need for sustainable energy solutions through the rapid discovery of alternative solar cell materials with the potential to enhance or replace silicon. The project is linked to a new robotic research platform located at the Melbourne Centre for Nanofabrication (MCN). The objective is to develop automated data analysis and machine learning algorithms to help with on-the-fly data analysis to guide our materials discovery.

Project Details

This summer project is part of the Australian Centre for Advanced Photovoltaics (ACAP) research program. It is based on a novel robotic platform, capable of (1) the formulation of coating solutions, (2) the fabrication of thin semiconductor films from these coating solutions and (3) the structural, optical and electrical characterization of these films. The platform is designed to run autonomously for at least 24 hours and produce thousands of samples of novel semiconductors every week. Characterization techniques include UV/VIS and fluorescence spectroscopy, time resolved fluorescence and microwave photoconductivity, optical profilometry and thin film x-ray diffractometry (XRD).



Figure 1. ACAP Energy Materials Platform, located at the MCN. (a) Front view of the multi-glovebox system hosting the platform, (b) Formulation capability, including gravimetric solid dispensing tool, (c) Film formation capability.

The large amount of data produced by this platform provides opportunities and challenges. On the one hand it holds invaluable information which will allow us to evaluate the performance of these materials and direct the experimental workflow. On the other hand it requires automated processes to derive physical properties of the produced samples and ultimately a figure of merit for their photovoltaic. Machine learning algorithms can then use this data to model parameter spaces, suggest new experiments or even autonomously drive the discovery process through active learning.

In your summer project you will join the team of researchers using the ACAP robotic platform and help to develop robust, automated data analysis routines, as well as machine learning algorithms to model parameter spaces. There is also an opportunity to contribute to the actual, ongoing materials discovery research in our group.

Prerequisites

We welcome enthusiastic students who combine a strong background in data science, machine learning and programming (python/matlab) with knowledge in physical science (materials, physics, physical chemistry, spectroscopy).

Additional Information

Applicants may be required to attend an interview. See our robot in action: <https://vimeo.com/900141694/86fd59b4d7>

Links: (1) <https://anff.org.au/news/using-ai-to-capture-sunlight/> (2) www.monash.edu/engineering/about/news/articles/2024/self-healing-solar-cells-could-become-reality