SEMS: RESEARCH PROJECT DESCRIPTION

1. Project Background and Description

This PhD project aims to investigate the ecotoxicological impact of perovskite solar cells and solar modules, a highly promising next generation photovoltaic technology beyond conventional silicon-based photovoltaics. This will be achieved by qualitatively and quantitatively investigating the leaching mechanisms of lead (Pb) and other harmful substances from various types of high performance perovskite photovoltaic materials and devices into the local environment, as well as their uptake mechanisms in biological organisms. This project further aims to build upon the new knowledge to develop a new generation of high performance and low ecotoxicity perovskite semiconductors and devices, thereby paving the way for the commercialisation of high performance and eco-friendly perovskite solar cells.

2. Project Scope

This project consists of four specific research objectives, detailed below:
1. To identify the major Pb leaching products, among other harmful substances, in addition to their leaching pathways, of established high performance perovskite semiconductors, as well as identify the uptake mechanisms of Pb into the local ecological system through bioassays;

2. To utilise such ecotoxicity analysis to establish a new knowledge framework unravelling the materials and device structure-ecotoxicity relationships of perovskite semiconductors and devices;

3. To further implement this framework to develop a new set of materials and device design rules to enable the substantial reduction (>100 fold) of the leaching rate of Pb and other harmful leaching products both under aqueous and soil environments;

4. To incorporate and balance these design rules with those established for performance enhancement to demonstrate, via an example, application of the newly developed perovskite materials in high performance and eco-friendly perovskite solar cells.

3. Desired Skills from the Student

Experiments will be conducted to understand how the leaching of lead and other harmful substance is dependent upon the materials and device design of perovskite solar cells. Testing include chemical analysis of the leachates, structural characterisation of different types of perovskite thin film and device samples. Results will be used to develop a new class of perovskite photovoltaic materials and devices with high performance and low ecotoxicity.

4. Supervisory Team

Primary: Dr Zhe Li

Secondary: Dr Han Zhang