SEMS: RESEARCH PROJECT DESCRIPTION

1. Project Background and Description

Scalable deposition of double perovskites for stable, non-toxic photovoltaics

Hybrid inorganic-organic perovskite solar cells (h-PSCs) have rapidly accelerated in efficiency in the last 10 years to become a leading technology in the photovoltaic (PV) research landscape, with record efficiencies over 25%, now competing with silicon. However, these efficiencies are achieved on very small areas, and large-scale production of these devices is still a challenge. In recent years our group has been pioneering the use of aerosol-assisted chemical vapour deposition (AACVD) to produce the materials used in h-PSCs [1,2]. This technique is well-established in industry and is capable of rapid, large-area deposition of materials such as oxides for glazing applications thus is inherently scalable.

Two key issues however remain with current h-PSC materials: their toxicity (as they contain lead), and stability towards moisture, air and even light. To this end, research is growing in alternative materials to overcome these issues, with all-inorganic double perovskites, such as $Cs_2AgBiBr_6$ receiving increasing interest [3]. There are also a wide family of related double perovskite materials, many of which have not yet been synthesized. Beyond scalability, another key advantage of AACVD is its ability to easily and rapidly screen a range of compositions, and produce pure-phase materials. Thus this project will use AACVD to produce a range of promising inorganic double perovskite materials, build PV devices and assess their efficiency with the key goal of identifying compositions with the potential for increased efficiency and stability, and therefore implementation as a future low-cost PV technology.

*[1] CrystEngComm **17**, 7486 (2015).*

*[2] Materials Letters **217,** 251. (2018).*

*[3] ACS Energy Lett. **3**, 8, 1781 (2018).*

2. Project Scope

Three research project objectives

- *Demonstrate deposition of double perovskite $Cs_2AgBiBr_6$ using AACVD and characterize properties;*
- *Fabricate and test solar cell based on $Cs_2AgBiBr_6$ to assess efficiency and stability;*
- *Screen further double perovskite materials and compare their PV efficiency.*

3. Desired Skills from the Student

- *Physical science background (e.g. Physics, Chemistry or Materials Science) or Engineering with some basic science knowledge*
- *Prior knowledge of theory of semiconductor materials and their interaction with light*
- *Experience of working in a chemistry laboratory or similar*

4. Supervisory Team

***Primary**: Dr Joe Briscoe, Lecturer (Assistant Prof) in Functional Materials.*
***Secondary:** Dr Zhe Li, Senior Lecturer (Associate Prof).*