Position Description

Position Title: Swinburne Masters (by Research) Scholarship 2020
Position Number: New
Classification: Masters Student
Faculty/PAVE Centre/Organisational Unit: FSET / Fluid and Process Dynamics (FPD) Group
Department: Mechanical and Product Design Engineering

Masters (by Research) Project Title

Partitioning of Ag, B, P in Liquid Silicon and Oxides during Recycling and Refining of End-of-Life (EoL) Photovoltaic (PV) Cell

Position Purpose

A Masters (by Research) scholarship is available for a suitable candidate to undertake masters project on "Partitioning of Ag, B, P in Liquid Silicon and Oxides during Recycling and Refining of End-of-Life (EoL) Photovoltaic (PV) Cell". The successful applicant will carry out the research work closely with Swinburne Researchers, CSIRO (Commonwealth Scientific and Industrial Research Organisation, Australia) and related industry partners.

There is a genuine worldwide problem of an growing generation of WEEE (waste electrical and electronic equipment), i.e. about 40 million tonnes per year. WEEE contains of more than 40 elements including the strategic metals and hazardous elements. The concentrations of the strategic metals in the WEEE are higher compared to that of in their respective underground ores. This makes them suitable as secondary metals sources. End-of-Life (EOL) Photovoltaic (PV) cell is also considered as WEEE. Considering the average panel lifetime of 25 years, the global solar PV waste is anticipated to be between 4-14% of total generation capacity by 2030 and rise to over 80% (~78 million tonnes) by 2050. In addition to the Si, EOL PV cell contain very valuable Ag which is used as metallisation pastes/inks in the cell. There is also a problem of Si kerf (slurry) waste generated during the manufacturing of PV Cells(account for up to 45% loss of ultrapure materials), totalling to approximately 160,000 tonnes/year (and increasing if not processed).

The masters project is part of a broader project to develop a unique pyrometallurgical process that allows high volume and high throughput recycling and processing of end-of-life (EoL) Si Photovoltaic (PV)-cells and alternative silicon source (e.g. Si kerf). The process involves the application of voltage through electrodes placed across molten silicon and slag phases during slag refining reactions. This results in the removal of impurities (such as Boron (B) and Phosphorus (P)) at much faster rates and higher amounts compared to the regular slag refining or current Si production process; and at the same time promotes maximum recovery of high value Silver (Ag) from EOL-PV, making the overall recycling process economically attractive.

This proposed masters project will investigate the partitioning of elements (Ag, B, P) between liquid silicon and liquid oxides during their refining reactions. The project will involve both experimental and thermodynamic modelling study. In particular, the project will:

1) Conduct high temperature equilibrium experiments between liquid silicon and liquid oxides/slag
2) Measure the partitioning of Ag, B, P between liquid silicon and liquid oxides/slag.
3) Conduct detailed materials, chemical and slag structure characterisation using appropriate technique.
4) Develop a model that relates the partitioning, temperature, oxygen partial pressure with slag structure.

The scholarship funding is for 2 years for the Masters study, but student may have an opportunity to transfer to a PhD program (3 years program). The successful applicant will be invited to submit an application for entry into a Masters by Research program and satisfy the general requirements of entry at Swinburne University of Technology, please see (https://www.swinburne.edu.au/courses/applying/how-to-apply-research-degree/).

The scholarship offered will be consistent/equivalent to the SUPRA (Swinburne University Postgraduate Research Award) scholarship at the University. The 2020 SUPRA stipend rate is $28,092 per annum with the following conditions

i. Annual indexation.

ii. Provisions for paid leave (maximum of 8 weeks/56 days of paid leave, plus provision for paid maternity/paternity leave)

iv. A thesis allowance (maximum $840 for a PhD)

v. A relocation allowance ($505 for each eligible adult and $255 for each eligible child – maximum total allowance is $1,455)

vi. Tuition fee waiver/scholarship up to two years

Location

The research will be carried out at Swiburne University of Technology (Hawthorn, Melbourne, Australia) and CSIRO (Clayton, Melbourne, Australia). The successful applicant may spend time at both locations (30 minutes apart) to carry out the project. The successful applicant may need to travel to present research finding to the funding body, at conferences, or visit industry collaborators.

Key Responsibility Areas

Research	Work towards research objectives, ensuring close liaison with Supervisors and industry partner/collaborator. Planning and execution of relevant research work and data analyses, including modelling, survey and experimental study relevant to the project. Maintain a high-quality record of regular and original research publications of high international standing including peer reviewed journal papers. The following general research program is proposed in carrying out the project: i) A literature review completed to assess the current state of knowledge around partitioning of elements in silicon-slag systems. ii) Experimental study to collect partitioning data and samples. iii) Analyses of samples and data to establish model relating partitioning, temperature, and slag structure. iv) Writing of papers and reports. v) Completion of Masters thesis. This program of work may change as the student develops the project and these changes will be discussed with the student's supervisors and external collaborators.
Swinburne Behaviours	· Commitment to the Swinburne Behaviours of: · Communicate – Say it – have the conversation, respect each other's differences, give meaningful feedback and share honestly and openly · Listen and Learn – Hear it, learn from it – learn from one another, actively listen to each other, resolve conflict and be innovative · Collaborate – Share it – work constructively together with a common purpose to achieve the university's goals · Trust – Trust it – be open to and with others, act with fairness and respect, inspire positive expectations and communicate effectively · Act – Do it – have a strong sense of immediacy, take practical action and see it through
Other	· Undertake Department-wide and/or university-wide responsibilities as required.

Key Selection Criteria

Candidates are required to respond to each of the selection criteria below

Key Selection Criteria		Essential / preferable
Qualifications	Bachelor of Engineering (4 years); Bachelor of Applied Science (4 years)	Essential
Experience/ Knowledge/Attributes	Background in Process/Extractive Metallurgy, Chemical/Environmental Engineering, Materials Engineering or Mechanical Engineering	Essential
	Experience in conducting research; in particular in high temperature experiments and modelling	Preferable
	Proficient interpersonal and communication skills, including the ability to work within a diverse team	Essential
	Experience in using computer software modelling (thermochemical packages, flowsheeting packages, etc)	Preferable
	Industrial experience in a process/metals industry	Preferable
Other	English Language Requirement (e.g. IELTS: Overall 6.5, No individual band below 6.0) (Australian Universities English Requirement)	Essential

Further information and how to apply

Please submit expression of interest (EOI) for this PhD scholarship position to Professor Akbar Rhamdhani (ARhamdhani@swin.edu.au) by using email subject "EOI-Swinburne Masters Scholarship-Partitioning of Ag, B, P in Liquid Silicon and Oxides". Please include a copy of your CV, academic degrees, academic transcripts, English test results (IELTS or TOEFL) and copies of journal publications (if applicable).

The deadline for the EOI is 31 August 2020.

For further information about the position, please contact Professor Akbar Rhamdhani at ARhamdhani@swin.edu.au.

Relevant weblinks:

Swinburne	https://www.swinburne.edu.au/
FPD Research Group	http://www.swinburne.edu.au/science-engineering-technology/research/fluid-and-process-dynamics/
Application Process	https://www.swinburne.edu.au/courses/applying/how-to-apply-research-degree/
CSIRO	https://www.csiro.au/