Project Title*:	**Gas Diffusion Electrodes for continuous electrochemical CO2 reduction to chemical feedstock**
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Faculty Research Area (Theme)*:	Advanced Materials
School Research Area*:	Energy
Applicable to other Engineering schools/disciplines:	Sciences – Maths, Physics, Chemistry
Abstract*: (Maximum 200 Words)	It is generally accepted that ideal CO2RR catalysts should possess the following characteristics: (i) high product selectivity for CO2RR and suppression of HER, (ii) long term stability, (iii) large current density, (iv) lower overpotential and (v) low fabrication costs. Most electrocatalysts however suffer from the drawbacks of requiring high overpotentials and typically exhibit a trade-off between selectivity and current density. To circumvent such challenges, in-house PartCat have developed three-dimensional and porous Ag Foam electrodes that converts CO2 to CO. The next step is to further minimize catalyst costs through fabrication of metal-free Graphitic Carbon Nitride/Carbon Nanotube Composite catalysts and further improve the performance of the catalyst through defect engineering. This catalytic performance is among the highest of metal-free catalysts and is even on par with the benchmarked metallic catalysts. Most of the electrodes used in the electroreduction of CO2 are the in the above mentioned form of metal plates, metal granules, or electrodeposited metals on a substrate. However, due to low solubility of CO2 in water under ambient conditions, the reaction rates and current densities of CO2RR are limited by mass transfer of CO2 from the bulk to the solid electrode surface. To improve the reduction process, gas diffusion electrodes (GDE) have been proposed to improve mass transfer limitations across the gas liquid interface and to the catalyst surface.
Research Environment: (Maximum 100 Words)	The students selected for this project will be given opportunity to work in Particles and Catalysis Research Group (PartCat) at School of Chemical Engineering, under the supervision of Scientia Professor Rose Amal, and Dr Xunyu Lu. The students will have access to state-of-the-art experimentation facilities, mentoring opportunities and fun and nurturing working environment to gain necessary expertise facilitating their career in industry or academic research. Further information can be obtained by contacting Professor Rose Amal (r.amal@unsw.edu.au).
Novelty and Contribution: (Maximum 100 Words)	A GDE is a porous composite electrode made of polymer bonded catalyst particles on a carbon support. As GDE can be operated at higher current density, exhibiting high porosity and partial hydrophobicity, GDEs form a characteristic gas-solid-liquid three phase interface, which promote homogenous distribution over catalyst surface.
Expected Outcomes: (Maximum 100 Words)	The aim of this project is to develop a high throughput gas diffusion electrode system and optimized the catalyst performance to improve the production rate of alcohol, so to make this technology financially viable.
Reference Material Links:(Maximum 100 Words)	References: [1] Han et al. ACS Energy Lett., 3 (4), 855–860, (2018) [2] Daiyan et al. ChemistrySelect 2 (3), 879-884, (2017) [3] Lu et al. Chemistry–A European Journal 22 (34), 12200-12200 (2016) [4] Weekes et al. Acc. Chem. Res., 51 (4), 910–918, (2018)

Will the student visit the premises of an industry partner, or undertake any activity on premises external to UNSW?*	No