Bath Monash Global PhD Programme in Sustainable & Circular Technologies

Project Title:	Aluminium boryl complexes for catalytic CO_2 deoxygenation
Supervisors at Monash (Home institution)	Dr Drakso Vidovic
Supervisors at Bath (Host institution)	Dr David Liptrot
Indicative period at Bath	18

Project Summary (to include a brief description of the relevance to sustainable & circular technologies)

Catalysed reactions, in general, reduce energy requirements, reaction times and waste formation in comparison to non-catalysed procedures. In recent years, owning to the evolution of green chemistry and sustainable development concepts, the use of Earth abundant and, hence, inexpensive elements has been the focus for catalyst preparations. Therefore, this project will be centred on the synthesis and subsequent activity of novel catalysts based on copious and inexpensive aluminium. In particular, complexes containing aluminium, as the most abundant metal in the Earth's crust, will be exploited in concert with boryl anions, an emerging class of compounds which can facilitate a number of remarkable transformations.

We propose to prepare aluminium complexes containing acyclic bis(amino)- or bis(alkoxyl)-boryl ligands for catalytic deoxygenation of CO_2 to produce CO. The group of Dr Vidovic has recently devised a unique synthetic procedure for the synthesis of bis(amino)borane compounds ($(R_2N)2B$-H) while the group of Dr Liptrot has prepared a bis(alkoxyl)copper complex. Thus, our proposal will focus on the preparation of various aluminium boryl compounds by (i) oxidative addition of bis(amino)boranes to a source of Al(I) or (ii) transmetalation of Cu-boryls with various Al (III) compounds. Once the target aluminium-boryl complexes are prepared they will be tested as catalysts for CO_2 deoxygenation to yield CO. Catalytic reduction of CO_2 has the potential to greatly enhance the use of CO_2 as a C_1 feedstock via its transformation to a reactive synthon, CO, that is currently used in e.g. the Oxo process which is responsible for kiltotonnes of surfactants, but which uses hydrocarbon derived CO. The ability to replace this with CO derived from atmospheric CO_2 would be a significant step in both emission remediation, and movement away from fossil fuels.