Project Title:	**Well-dispersed dual cocatalysts (metal-MoOx) on TiO2 for photocatalytic water splitting**
Name of Supervisor:	Jason Scott
Email of Supervisor:	jason.scott@unsw.edu.au
Name of Joint/Co-Supervisor:	Judy Hart
Email of Joint/Co-Supervisor:	j.hart@unsw.edu.au
School:	School of Chemical Engineering
Faculty Research Area (Theme):	Advanced Materials
School Research Area:	Energy
Applicable to other Engineering schools/disciplines:	Sciences – Maths, Physics, Chemistry
Terms:	Term 2 Term 3
Abstract:	Solar photocatalysis for producing chemical fuels is seen as a future contributor to addressing the looming energy crisis and environmental problems. The key component of this technology involves establishing an efficient photocatalyst that is able to drive the water splitting reaction. However, currently available photocatalysts have a serious drawback in that they suffer from fast recombination of the active photogenerated charge carriers. One solution is to immobilize cocatalysts on photocatalyst surface to improve charge separation as well as favour the catalytic reaction. TiO2 with its high stability, low cost and non-toxic nature is the most widely investigated photocatalyst for photo-reducing water and CO2 to produce clean energy resources. Adding atomic/molecular-sized cocatalysts is expected to boost photocatalysis by the TiO2. The proposed project will use small inorganic molecules (XMo6O24, X=Ni, Co, Cu, Zn) to fabricate metal single atom and MoOx (approximately 2 nm size)-decorated TiO2 for photo-reducing water and CO2 into valuable products.
Research Environment:	The successful candidate will work in the laboratories of the Particles and Catalysis (PartCat) Research Group under the guidance of A/Prof Jason Scott and alongside established PhD students. They will learn to fabricate the promising neat and cocatalyst-loaded TiO2 photocatalyst materials, conduct solar water splitting/CO2 reduction experiments and operate advanced characterization instruments.
Novelty and Contribution:	A unique catalyst structure in the form of inorganic XMo6O24 blocks, well-dispersed in an atomic arrangement (on the TiO2) will be fabricated. The metal (X= Ni, Co, Cu, Zn) will be present as a single atom wrapped in Mo6O24 clusters. The blocks will be reduced to well-dispersed X-MoOx on TiO2. The single metal atom will be key for photogenerated electron transport, favouring photogenerated electron separation and transfer from TiO2 to the catalytically active X-MoOx clusters. Harnessing of the photogenerated electrons will be significantly enhanced due to more efficient active sites and longer electron lifetime of electrons arising from multisite transfer
Expected Outcomes:	The proposed research is designed to deliver active and efficient materials to sustainably produce renewable energy sources (e.g. H2, CO, CH4). It will allow prospective students to work in a research team and to critically think about real and current problems and solutions. The student will gain a clearer appreciation of research and what it involves over the course of the program. Materials

development providing an effective and useful photocatalyst will lead to the work being published in an international peer-reviewed journal

Reference Material Links:

(1) T. H. Tan, R. J. Wong, J. Scott, Y. H. Ng, R. A. Taylor, K. F. A. Zinsou, R. Amal, ACS Catal. 2018, 8, 7158-7163.

(2) Y. Wang, H. Arandiyan, J. Scott, K. F. A. Zinsou, R. Amal, ACS Appl. Energy Mater. 2018, 1, 6781-6789.

Will the student visit the premises of an industry partner, or undertake any activity on premises external to UNSW?