Title	France/Australia co-tutelle PhD: Precipitation kinetics of core-shell Al_3Sc/Al_3Zr particles and associated strengthening mechanisms
Abstract	Scandium is known to be one of the most efficient strengthening addition elements in Aluminium alloys. The strength increment comes from the formation of nanometric $L1_2$ Al_3Sc precipitates. In the past, Scandium has found very limited commercial applications due to its scarcity and high price. However, this will soon change with the use of a novel extraction technology that will enable a significant drop in price in the near future. Scandium is often added together with Zr as it results in the formation of core-shell precipitates with an Al_3Sc core and an Al_3Zr shell. This core-shell morphology is driven by the differences in Sc and Zr diffusivities in Al (~3 order of magnitude). As such, Al_3Sc nucleates first and then Al_3Zr forms a thermally stable shell. These core-shell precipitate are thermally stable during subsequent heat treatment steps. The existing precipitation kinetics model are not able to describe properly the precipitation of core-shell precipitates. The interaction between these spherical precipitate and dislocations is also unknown. Particularly, how the core-shell morphology will affect the shearing and by-passing mechanisms. During this PhD, model Al-Sc-Zr alloys will first be cast. The formation kinetics of Al_3Sc/Al_3Zr will be characterised using a combination of transmission electron microscopy, atom probe tomography and small angle x-ray scattering experiments. The impact of precipitation on mechanical properties will also be measured using hardness and tensile tests. HAADF-STEM microscopy will be conducted ex-situ on deformed samples to characterise the interaction mechanisms between the core-shell precipitates and moving dislocations. A model will be developed to describe the precipitation kinetics of core-shell precipitates and related yield strength increment.
Context	This research is funded by Deakin University and co-supervised with INSA Lyon. This project will result in double PhD degree with the two institutions. The core of the student's project will be spent at the Institute for Frontier Materials (Deakin University). The student will also spend at least 1 year at MATEIS (INSA). The student will have the opportunity to conduct experiments at large instruments (Australian Synchrotron, ESRF). A collaboration with the SIMAP laboratory (Grenoble, France) to conduct SAXS experiments is also a possibility.
Value and duration	The scholarship is valued at up to $27,596 per annum (tax free) for 3 years with a possible 6 month extension. A relocation allowance covering one one-way airfare to Australia is also available for international students. An additional travel allowance will be provided for travels to France during the PhD. Health coverage in Australia is provided for the duration of the PhD.
Eligibility	To be eligible for this scholarship you must: • have a first class honours or 2a honours or equivalent in materials, manufacturing or mechanical engineering, physics or chemistry • provide evidence of good oral and written communication skills • Demonstrate ability to work as part of a multi-disciplinary research team.

	• meet Deakin University’s entry requirements for the higher degree by research
Open date	Applications now open.
Close date	Applications will close when a candidate is selected.
Terms and conditions	Read the Deakin University Research Scholarship Terms and Conditions.
Further info	Project anticipated to be conducted in conjunction with the MATEIS laboratory (INSA Lyon) and the SIMAP laboratory in Grenoble. The double degree will be between Deakin University and INSA Lyon.
Contact	For further information contact Prof Damien Fabregue (INSA) : damien.fabregue@insa-lyon.fr