

MONASH CENTRE FOR ELECTRON MICROSCOPY

HAADF-STEM and APT characterisation on solute clustering and precipitation of Al-Cu-Mg based composites produced by additive manufacturing

Date: Thursday, 26th June 2025

Time: 11:00 – 12:00PM

Venue: Theatre S12,
16 Rainforest Walk, Monash Clayton Campus



Priv.-Doz. Dr. Jiehua Li,

*Montanuniversität Leoben,
Leoben, Austria*

Abstract

Al-Cu-Mg based alloys (i.e. 2024 alloy) have been widely used in aerospace industry due to their high strength and light weight. However, Al-Cu-Mg based alloys have a significant hot tearing tendency and a serious segregation issue due to their large solidification range. An effective grain refinement can be used to solve the hot tearing and segregation issues. Although the addition of 0.1 wt.% TiB₂ (as grain refiner) into Al-Cu-Mg based alloys can refine grain size down to 200 μm , it is still not enough to reduce or avoid the hot tearing and segregation issues. In this talk, the addition of 3 wt.% TiB₂ (as grain refiner) into Al-Cu-Mg based alloys (regarded as Al-Cu-Mg based composites) will be investigated, which can refine grain size down to 50 μm and thereby greatly reduce hot tearing tendency and segregation. Furthermore, additive manufacturing (laser powder bed fusion) was used to produce rods with a diameter of 16 mm and height of 200 mm. The solute clustering and subsequent precipitation of Al-Cu-Mg based composites produced by additive manufacturing was investigated by using high-angle annular dark-field scanning transmission electron microscopy (HAADF-STEM) and atom probe tomography (APT). A significant solute clustering (Mg-Ag-rich) was observed after the solution treatment (T4). After further over-ageing treatment (T7), three different types of precipitates (Al-Cu (θ) phase, Al-Cu-Mg-Ag (Ω) phase and Mg-Si (β) phase) were observed, which is fully consistent with the case of samples produced by conventional gravity die casting condition. More interestingly, one Mg, Ag-rich layer was observed in the vicinity of Al-Cu (θ) phase. These careful HAADF-STEM characterizations and quantitative atom probe data analyses give us some hints to design high performance Al-Cu-Mg based composites.

Biography

Priv.-Doz. Dr. Jiehua Li graduated and obtained his Ph.D. degree from State Key Laboratory of Solidification Processing, Northwestern Polytechnic University in 2010. During his Ph.D study (from 2008-07 to 2009-08), he also worked as a joint Ph.D candidate in Australian Centre for Microscopy and Microanalysis, University of Sydney, Australia.

After his Ph.D in January 2010, he moved to Austria and worked as University Assistant in Chair of Casting Research (Lehrstuhl für Gießereikunde), Technical University Leoben (Montanuniversität Leoben). In July 2014, he was promoted to Senior Lecturer in Chair of Casting Research (Lehrstuhl für Gießereikunde), Technical University Leoben (Montanuniversität Leoben). On May, 2015, he was promoted to Privatdozent.

His research works mainly focus on (i) melting metallurgy, (ii) high performance alloys, (iii) solidification principles, (iv) advanced casting technologies, and (v) advanced scanning / transmission electron microscopy and atom probe tomography.

On the basis of his research work, 45 first-authored and 70 co-authored, peer-reviewed papers have been published in prestigious journals, including Acta Mater. (12). H-index: 31. Total indexing: 3526 (Google Scholar update on 2025-05-17). He was the winner of the international prestigious HZG Magnesium Research Award in 2017. In 2018, he was awarded a Humboldt Research Fellowship for Experienced Researchers, worked as guest researcher in Max-Planck-Institut für Eisenforschung (Max-Planck-Institute for Steel Research) (now Max-Planck-Institut für Nachhaltige Materialien, Max-Planck-Institute for Sustainable Materials) with a host of Prof Dr Dierk Raabe (four months every year in 2018 (June to September), 2019 (June to September), 2021 (November 2021 to February 2022)).

Convener: Professor Laure Bourgeois

Email: mcem@monash.edu **Tel:** 9905 5563