

AM @ RMIT

M. Brandt

Director

Advanced Manufacturing Precinct - Digital Manufacturing Facility
Centre for Additive Manufacturing

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What's next...

RMIT Centre for Additive Manufacturing - 2014

RCAM Vision



To be a global research leader in digital additive manufacturing delivering innovative solutions to industry.

Academic
Members

21

Visiting
Professors

4

average per year

Full-time
Researchers

16

PhD Students

>35 current

>120 graduated
(since 2014)



Key researchers



Prof Milan Brandt
AM, laser,
materials,
manufacturing



Prof Kate Fox
AM, surfaces,
biomaterials,
manufacturing



Prof Ma Qian
Materials
metals, materials,
Ti expertise



A/Prof Jonathan
Tran
Civil, modelling
AM concrete



A/Prof Andrey
Molotnikov
Technology
laser, materials,
sensors,
manufacturing



Prof Mark Easton
metals, materials,
Al alloy expertise



Prof Raj Das
Modelling
Modelling, AM,



Prof Martin Leary
Design
AM, design for
AM



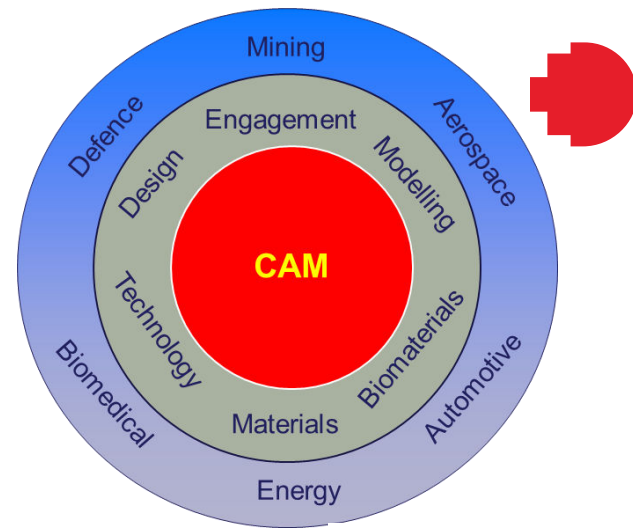
Prof Pier Marzocca
aerospace structures



Prof Cui Wen
Biomaterials
materials, metals,
biomaterials



Prof Stuart Bateman
AM, polymers,
manufacturing



CAM Theme Leaders

AMP

Undertaking fundamental and applied research and training in digital additive manufacturing in support of the local manufacturing industry

- World class \$30m research and teaching facility – opened 2010
- Unique in Australia – covers both metal and polymer based technologies together with high-end CNC machines, 3D scanning, mechanical testing (**One stop shop for Industry**)



RMIT Additive manufacturing capability - 2023

Polymer

FDM – Fortus 900mc, Zortrax, Markforge



MJ – Polyjet J750, Connex 350,



SLA – 3D Systems Project 7000, DLP systems

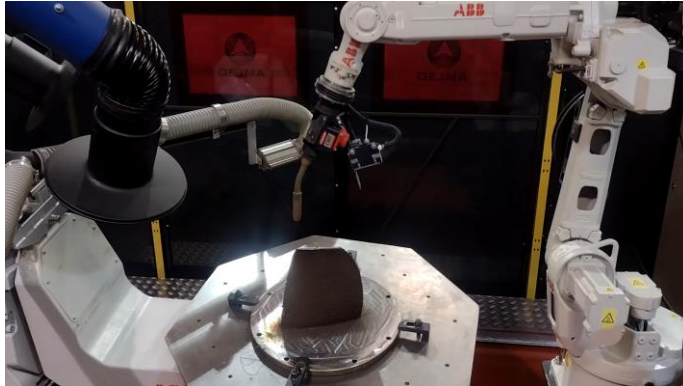
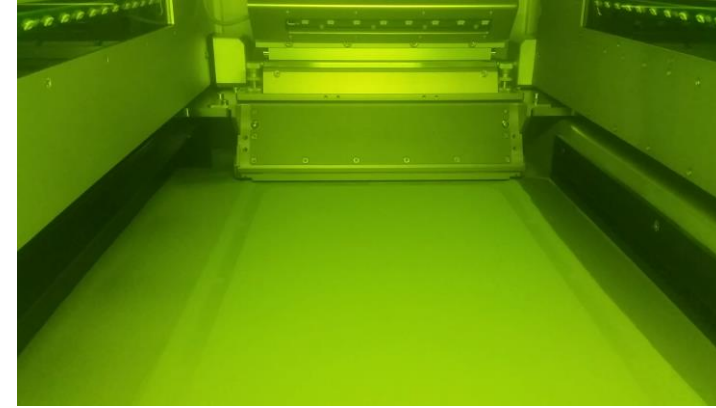
RMIT Additive manufacturing capability - 2023

Metal

LPBF – SLM Solutions 500HL,
2x250HL, 125HL, 280 HL (Dec
23)

Aconity Midi+

WAAM – AML3D



Aconity **MIDI+** – Multi-
Material, 1000deg, sensors

LMD – TRUMPF TruLaser 7020,
Range of thermal sensors,
Multi-material



RMIT Additive manufacturing capability - 2023

Supporting

CNC – 3 & 5 Axis machining centres

Metrology – 3D scanning, CMM, CT

Simulation – Virtual design, Optimisation

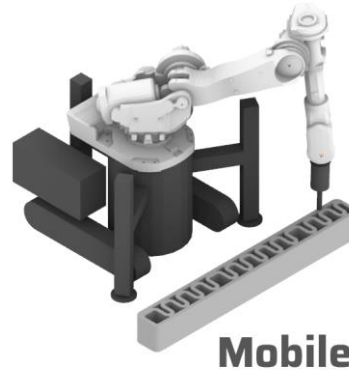
Mechanical Testing – Extensive capabilities



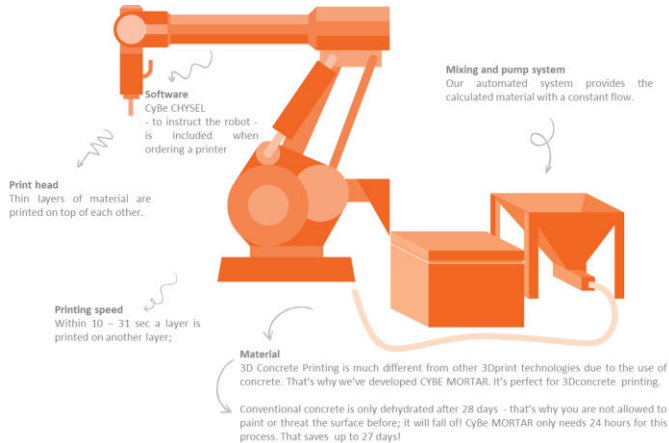
- **Topology optimisation (TOP)**, DFAM and SLM manufacture enables significant performance improvement



RMIT Additive manufacturing capability – Prefab construction



Mobile



- 200-600 mm/s print speed
- 4.5 m height & 2.75 m range
- Modular construction method

Applied research underpinned by high impact fundamental research

Article

Strong and ductile titanium–oxygen–iron alloys by additive manufacturing

<https://doi.org/10.1038/s41586-023-05952-6>

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 Check for updates

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Titanium alloys are advanced lightweight materials, indispensable for many critical applications^{1,2}. The mainstay of the titanium industry is the α - β titanium alloys,

α and β phases^{3–5},
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Node-reinforced hollow-strut metal lattice materials for higher strength

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ARTICLE INFO

Keywords:
Hollow strut
Lattice
Laser powder bed fusion
Metamaterials
Ti-6Al-4V

ABSTRACT

Intricate hollow-strut metal lattices are novel cellular materials or metamaterials. However, their hollow nodal regions often lead to premature failure under stress. This study reports a design strategy to substantially improve the strength of hollow-strut metal lattices by applying nodal reinforcement. The proposed nodal reinforcement designs increased the yield strength of hollow-strut Ti-6Al-4V cubic lattices by up to 144% and elastic modulus by up to 113% with a modest 21% increase in density compared to the unreinforced lattices. In addition, a 42% increase in peak stress was observed when compared to solid-strut Ti-6Al-4V cubic lattices of similar densities. These properties exceeded the empirical upper limits of the Gibson Ashby model for cellular metallic materials, thus extending the property envelope. Distinct failure modes were observed for the proposed nodal reinforcement designs. Numerical analysis clarified their role in determining the deformation response.



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Research paper

Ti-6Al-4V hollow-strut lattice materials by laser powder bed fusion

J. Noronha, J. Rogers, M. Leary, E. Kyriakou, S.B. Inverarity, R. Das, M. Brandt, M. Qian^{*}

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ARTICLE INFO

Keywords:
Hollow-strut lattice
Additive manufacturing
Mechanical properties
Ti-6Al-4V

ABSTRACT

Hollow-strut metal lattices are an emerging class of cellular metallic materials. However, their mechanical properties at relative densities (ρ_{rel}) higher than 10% are largely unknown because conventional manufacturing methods are ill-equipped to fabricate them. In this study, face-centered cubic (FCC) and FCC with Z struts (FCZZ) Ti-6Al-4V hollow-strut lattices with $\rho_{rel} = 8$ –16% were fabricated using laser powder bed fusion (LPBF) additive manufacturing (AM). Both lattice topologies exhibited yield strength (σ^*) and elastic modulus (E^*) at the upper bound difference in σ^* or E^* of FCC and FCZZ lattices. In addition to the lattice

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Variant selection in additively manufactured alpha-beta titanium alloys

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ABSTRACT

The crystallographic arrangements of the α -phase variants in α - β titanium alloys remains less identified due to the crystallographic complexity involved while being essential to understand the α - β microstructural intricacy. To improve the current understanding, specimens of two columnar-grained α - β Ti alloys (Ti-6Al-4V and Ti-6Al-2Sn-4Zr-2Mo) and two equiaxed-grained α - β Ti alloys (Ti-6Al-4V and Ti-6Al-2V) were fabricated by laser metal powder deposition (LMD). Electron backscatter diffraction (EBSD) analy-



Centre “firsts” based on fundamental research



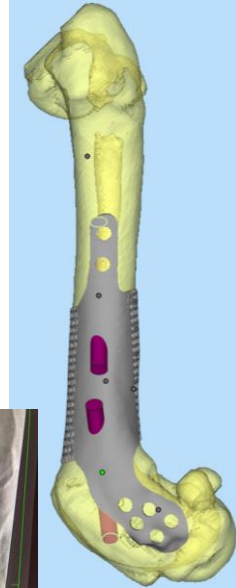
First 3D printed spinal disc in 2015 –
Collaboration with Anatomic



First 3D printed dog implant in 2019 –
Collaboration with UQ



Seymore 24h post op



First 3D printed satellite
chassis 2019/20 –
Collaboration with ADFA



Collaboration Partners



Agilent
Technologies

RUAG



FUTURiS



University of Wollongong



Australian Government
Department of Defence
Defence Science and
Technology Organisation



MONASH
University



Fraunhofer
ILT





Thank you for your attention.

Questions

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What's next...