

Development of Direct Laser Melting (DLM) deposition system for in-situ use on neutron beam instruments

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Abstract

Direct Laser Melting (DLM) deposition is an additive manufacturing technique in which a high power laser is used to create a melt pool on a workpiece into which metal powder is sprayed, resulting in localised material deposition. This technique is used in industry for additive repairs, cladding with dissimilar metals, or, in conjunction with a CNC milling machine, as a full-fledged 3D additive fabrication platform. As the prominence of this technology rises, so too does interest in characterising deposition dynamics over a vast parameter space. Neutron beam instruments offer unique capabilities for such characterisation.

As part of the NSW Research Attraction and Acceleration Program, ACNS is developing new sample environment capabilities enabling *in-situ* laser metal deposition, for use on KOWARI and DINGO instruments. The system will utilise a self-contained motion stage and laser cladding head which will construct a thin wall structure on a user specified substrate, utilising up to two metal powders at a time. Neutron studies of the melt pool or heat affected zone can then be performed during and after printing.

Capabilities

The in-situ DLM system is currently under development by the Sample Environment team at ACNS. This new system will allow the translation of a sample plate in two dimensions, building up a planar deposited structure in multiple passes. Neutron measurements may be taken during deposition, with the neutron beam positioned relative to the melt zone. Capabilities include:

- 2 kW laser power @ 1000nm focused to 2 mm spot size
- Dual coaxial powder feeders for deposition of arbitrary powder mixtures
- Translation rates up to 60 mm/s
- Laser preheating of sample
- Cooled sample fixture and multiple integrated temperature sensors to establish and measure temperature gradients
- Helium shield gas only
- Compatible with KOWARI strain scanner and DINGO neutron tomography

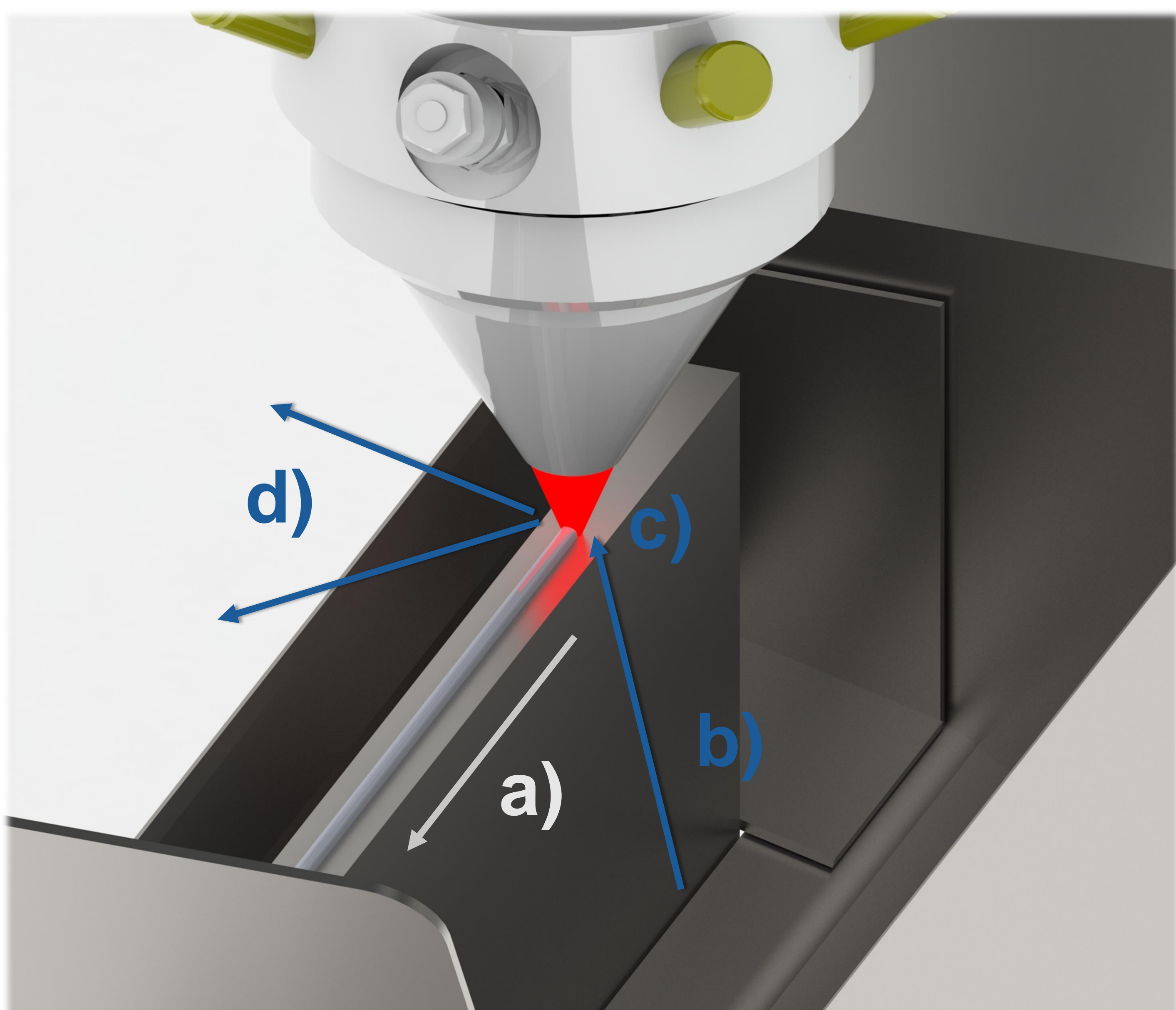


Fig 2. Schematic depicting geometry of in-situ DLM on KOWARI. Shown are: (a) direction of sample motion; (b) incident neutron beam; (c) melt zone; (d) scattered neutrons.

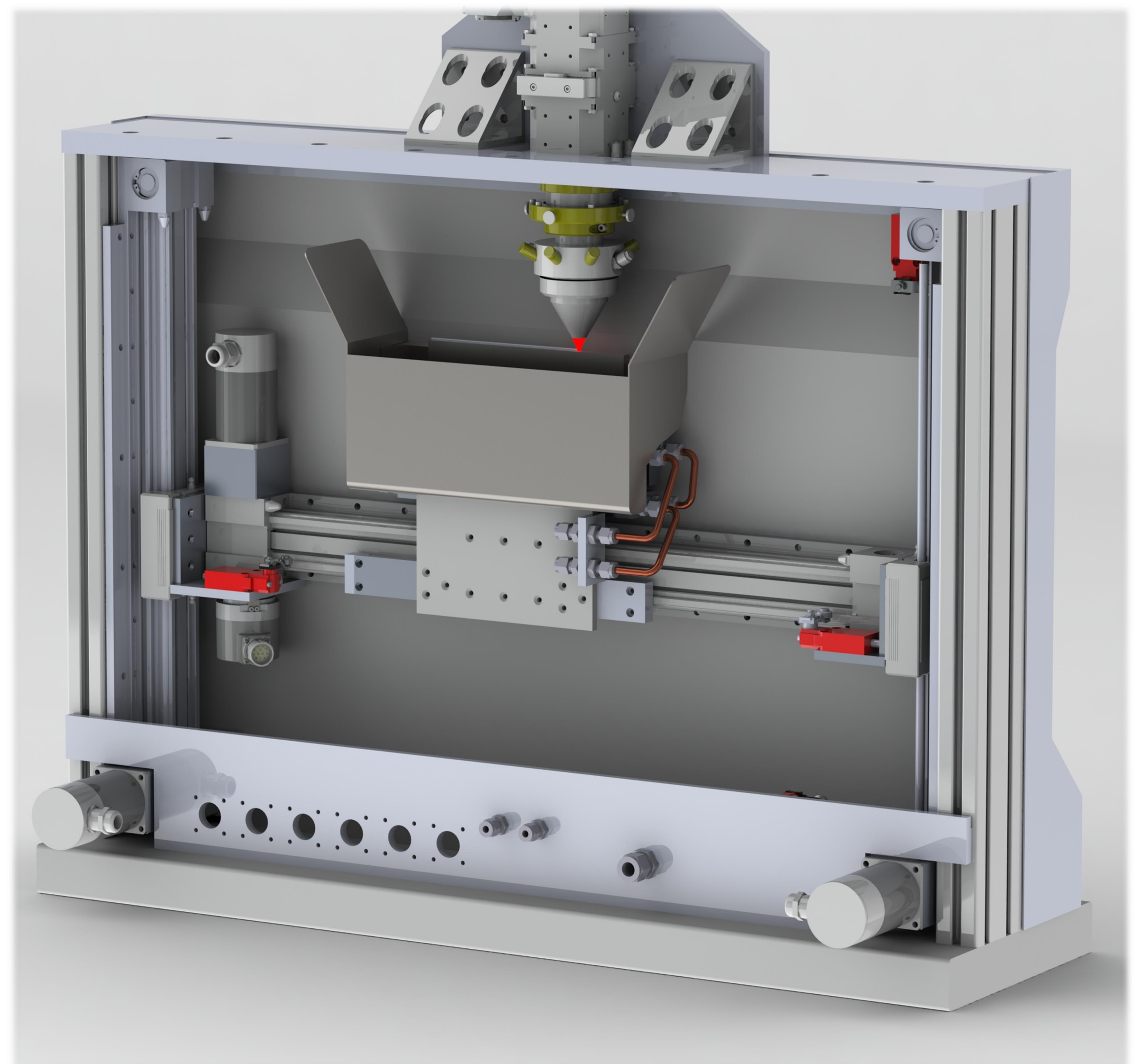


Fig1. CAD rendering of the in-situ DLM system currently under development

Contact us

DLM system will be available for laser cladding and additive manufacturing experiments on KOWARI from Q3 2021, and on DINGO from Q4 2021.

Contact the Sample Environment team at sample_environment@ansto.gov.au to discuss your experimental requirements

Acknowledgements

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