

**Advanced Materials & Processing Laboratory**  
**AMPLab**



**Additive Manufacture Research Day**

You are invited to attend the 2<sup>nd</sup> Research Day. The event will feature a number of talks by the group's researchers and students on the following topics:

- Selective Laser Melting
- Direct Laser Fabrication
- Microstructural Characterisation using Electron Microscopy and X-ray Tomography
- Residual Stress Characterisation using Neutron Diffraction.

The event will also include a tour of the experimental facilities of AMPLab.

**Thursday 17 October 2013**  
**Birmingham Research Park**  
**Vincent Drive, Edgbaston, B15 2SQ**  
**University of Birmingham**

**Supported by:**



**Programme**

9:00 - 9:30 am Registration, Tea  
 9:30 - 9:50 am AMPLab Introduction  
 Dr. Moataz M. Attallah, group leader

**Session 1: SLM of Advanced Alloys**

9:50 - 10:20 AM Technology Update  
 Mr. Colin Cater, ES Technology

10:20 - 10:45 SLM of Al- Alloys: Process Optimisation, Microstructure and Mechanical Properties  
 Dr. Noriko Read, AMPLab

10:45 - 11:10 Influence of Post-SLM Thermal Treatment on the Microstructural and Mechanical Properties Development in Ni-Superalloys  
 Dr. Luke Carter, AMPLab

**11:00 - 11:30 Tea Break**

**Session 2: Challenges with DLD**

11:30 - 12:05 Process Modelling of DLD of IN718  
 Lakshmi Parimi, AMPLab

12:05 - 12:30 DLD of Large Titanium Structures  
 Dr. Chunlei Qiu, AMPLab

12:30 - 12:55 Fabrication of Complex Structures using DLD  
 Dr. Xinjiang Hao, AMPLab

**12:55 – 1:45 Lunch**

**Session 3: AMPLab Outlook on AM**

1:45 - 2:10 AM of Novel Structures and Materials.  
 Dr. Nick Adkins, AMPLab

2:10 - 2:35 Laser Additive Manufacture Programme  
 Dr. Kiran Gulia

2:35 - 2:45 Concluding Remarks  
 Dr. Moataz Attallah

**2:45 Lab Tour starts**

**Delegate Registration**

Name: .....  
 Title & initials First name Surname  
 Position: .....  
 Organisation: .....  
 Address:.....  
 Post Code:.....  
 Tel: ..... Fax: .....  
 E-mail:.....  
 Dietary Requirements:

**Delegate Interests**

**Industry:**

- Aerospace  Automotive  Railway
- Defense  Metal processing  Academia
- Other: .....

**Interests:**

- SLM  DLD  Modelling
- Structural integrity  Process Development
- Other: .....

For further information, please contact us at

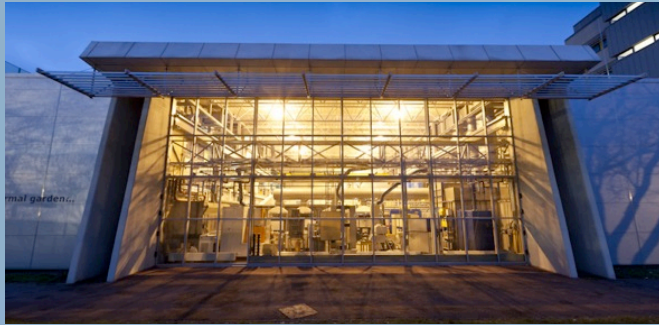
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## AMPLAB



The Advanced Materials and Processing Group (AMPLab) is based in the Interdisciplinary Research Centre (IRC) for Materials Processing, in the School of Metallurgy and Materials. The research programme carried out in AMPLab aims at understanding the influence of advanced materials processing techniques (additive manufacturing, powder processing, and solid-state joining) on the microstructure-property development in advanced materials. Simultaneously, the research activities aim at developing new materials, and assessing their process-ability using a number of advanced manufacturing methods. The research is performed in close collaboration with a large number of industrial end-users in the aerospace, defence, nuclear, and general engineering sectors, including Rolls-Royce plc, BAE Systems, Safran Group (Messier-Bugatti-Dowty and MicroTurbo), TWI Ltd, Meggitt, AEC, TIMET, and others). Current active projects approach in value £ 4.5 millions (2013), from the EU (CleanSky and FP7 programmes), TSB, EPSRC and a number of industrial contracts.

The scientific emphasis is on understanding the material-process interaction, utilising electron microscopy, synchrotron X-rays and neutron diffraction, and micro-tomography, to assess the impact of the processing method on the microstructural, structural integrity, and residual stress development. Typically studied manufacturing processes and materials include selective laser melting (SLM), direct laser fabrication (DLF), hot isostatic pressing (HIPping), and friction joining (linear friction, friction stir, and inertia friction welding) for ferrous alloys, titanium alloys, nickel superalloys, and aluminium alloys. The group hosts unique experimental systems, making it one of the centres of excellence in netshape manufacturing in the UK.



## AMPLab Facilities

AMPLab facilities include a Concept M2 Cusing® Selective Laser Melting (SLM) System. The system operates in an argon atmosphere for the processing of reactive powder systems, producing highly-dense components (>99.5%). The build envelope is 250 x 250 x 280 mm. The machine is powered by a 400 W laser system, with a variable focus diameter (70-200 µm). In addition, the group hosts a Trumpf Direct Laser Deposition (DLF) system, with a working volume of 1.5x3x1 m<sup>3</sup>, and a 4 kW disk laser system (operating in both continuous and pulsed wave). The facilities also include an EPSI Hot Isostatic Pressing (HIPping) system, with a temperature and pressure capacity of 1400°C and 200 MPa, respectively.

The group has access to the advanced characterisation tools at the School of Metallurgy and Materials, including its well-equipped Electron Microscopy Centre for characterisation of materials, thermal analysis suite (DSC and TGA), powder characterisation systems, and a full mechanical testing suite (fatigue, creep, crack growth, tensile, etc...).



Concept Laser M2 Cusing System



Trumpf DLF System



(c) EPSI HIP



(d) 3D Printing

## Additive Manufacture of Advanced Materials

Hailed as the third industrial revolution, additive manufacture (AM) has evolved from the plastics-based rapid prototyping techniques (stereolithography, laminated object manufacturing, selective laser sintering, etc...) to be applied for aerospace metallic structures, with improved capabilities with respect to the material, geometries, and properties.

AMPLab has been involved in a number of projects on AM, investigating the following topics:

- SLM and DLF process optimisation for metallic materials (Ti-64, Ti-5553, IN718, SC420, CM247LC, IN625, AlCuMg and AlSiMg alloys) to maximise the structural integrity of the builds.

- Microstructural and mechanical properties development due to SLM and DLF, and post-processing heat treatment and HIPping.
- Process modelling of DLF, to predict the residual stress development, combined with neutron diffraction measurements.
- The development of novel structures using SLM, and the non-conventional use of SLM to increase the deposition rates

For this event we have brought together AMPLab academic specialists and researchers on the use of laser AM technologies to present their latest work. The day will be an opportunity for discussions exploring the use of AM and networking for future funding calls.

**A particular highlight of the day will be the opportunity for the delegates to visit AMPLab AM facilities, including the SLM and DLF systems.**

## Who should attend?

- **Manufacturing, materials, and design engineers** looking to enhance production capabilities or simply to stay up-to-date of the latest developments in AM.
- **Academics and researchers** in materials and in laser materials processing.

## Registration

To register for the event, email the attached registration form to [amplab@contacts.bham.ac.uk](mailto:amplab@contacts.bham.ac.uk) or fax +44 (121) 414 7890.

## Travel

**Air:** Birmingham international airport is 17 miles away from Edgbaston.

**Rail:** Birmingham is the only University in mainland UK to have its own railway station on campus, known as 'University' station.

**Car:** SatNav B15 2SQ

## Accommodation

University offers a wide variety of accommodation options for all of our Conference Delegates from visiting students to visiting staff and international. Further information is available on <http://www.birmingham.ac.uk/international/visitors/accommodation.aspx>

