



Symposium Invited Speaker - I

Sponsored by the ASME Manufacturing Engineering Division's Manufacturing Processes Technical Committee

Date & Time: Tuesday, June 19th, 11am – 12:30pm, Room 103 (see MSEC2018 Technical Program for details)

“Metallurgical Issues and Quality Control in Selective Laser Melting of Aerospace Materials”

Professor Xinhua Wu

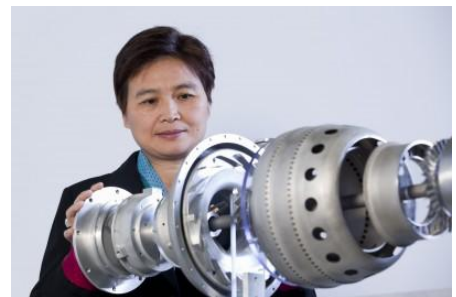
Director for Monash Centre for Additive Manufacturing (MCAM)
Monash University, Melbourne, Australia

Abstract

Selective Laser Melting (SLM), also called 3D printing, is being considered for aerospace and biomedical applications where properties, quality control and cost are critical. This presentation highlights the SLM research activities in Monash Centre for Additive Manufacturing, in particular on process optimisation and post heat treatment development in order to achieve required mechanical properties for Ti, Ni and Al alloys. Different materials have different issues in the SLM process, due to their metallurgical and crystallographic differences. Whilst elimination of cracking and retaining high temperature properties and stability are critical for SLM Ni alloys, optimisation of post heat treatment becomes more significant for Al alloys as defined by the nature of the sensitive response of precipitates of Al alloys during heat treatment. The optimum post heat treatment of SLM'd Ti64 has found to be totally associated with the completion of martensitic transformation where ductility of 18% and yield strength of > 900MPa can be easily achieved. Extensive study has been carried out in understanding the evolution of microstructure during solidification and post heat treatment and their influence on tensile and fatigue properties. Aerospace application requires controlling the quality from powder to SLM'd products as is demonstrated here using Ti64 alloy. To achieve equivalence to current international aerospace standards for wrought products, 9 batches of powder atomised from 3 lots of Ti bars, each lot weighing >3 tonnes, were used to make SLM samples using a laser powder bed system. More than 3000 SLM samples have been tested. It has been found that using appropriate quality of barstock followed by rigorous control of the atomisation and SLM processes, outstanding mechanical properties coupled with consistency and repeatability have been obtained in SLM'd Ti64 parts and this has led to the qualification of Ti64 powder and SLM'd parts for civil aerospace applications.

About Professor Xinhua Wu

Professor Xinhua Wu is the founder Director of Monash Centre for Additive Manufacturing and Director for Australia Research Council's Industrial Transformation Research Hub for high value manufacturing. She is a Fellow of Australia Technology, Science and Engineering(ATSE) and IoM³, UK. She is specialised in Ti alloys and in advanced powder processing, in particular 3D printing of metals. Prof. Wu has been actively involved in the research and design of alloys and manufacturing processes for aerospace and biomedical industries. Her research ranges from fundamental material sciences to their implementation in engineering components, from design to manufacturing, from laboratory demonstration to qualification and field testing. Some of her team's products are now flying in aeroengines, aircrafts or implanted in human body. Most notably her team produced the world 1st 3D printed jet engine in 2014. Prof. Wu has published over 130 journal papers, over 40 of them on additive manufacturing, holds 15 international patents, and has given over 30 keynote and invited lectures at leading international conferences, and organised 5 international conferences, and edited 3 conference proceedings. Prof Wu was awarded in 2008 the Ti award by IoM³, UK, for her outstanding record of world-class research in titanium and its alloys. In 2014 she received the top Innovation Award and Jury committee award from global aerospace giant Safran due to numerous SLMed engine parts passed engine tests. She and her industrial partners are also the recipient of Australia's 2016 Best Research Translation Award B/HERT (Business/High Education Round Table) Award.





Symposium Invited Speaker - II

Sponsored by the ASME Manufacturing Engineering Division's Manufacturing Processes Technical Committee

Date & Time: Tuesday, June 19th, 2pm - 3:30pm, Room 103 (see MSEC2018 Technical Program for details)

“Impulse Joining and Manufacturing: Methods and Opportunities”

Professor Glenn S. Daehn

Mars G. Fontana Professor of Metallurgical Engineering, Dept. of Materials Science and Engineering
The Ohio State University

Abstract

Explosive-like impulse can do remarkable things. Impact welding, for example can produce very strong welds between wildly dissimilar metals in a solid-state process, avoiding the intermetallic compounds that often cause brittleness. Explosive forming can dramatically extend forming limits and can avoid presses and fixed dies. This presentation will discuss many ways that explosive-like methods can be used in conventional lab or factory environments. Methods to be considered include:

- Chemical Explosives
- Vaporizing metal foils or filaments
- High speed presses
- Electromagnetic Lorentz interaction
- Laser Impulse

While these methods can offer vastly different pressure-time profiles with pressures ranging to GPa and time scales to tens of nanoseconds, all these methods offer opportunities very light equipment and enable new phenomena that can enable new methods of joining, forming, cutting and surface treatment. The operations discussed will include:

- Solid State Impact Welding
- Forming
- Surface Hardening
- Conformal Joining
- Shearing
- Powder Consolidation

We will provide a holistic picture of impact welding synthesizing simulations, instrumented experiments and joined metallic pairs (including high strength steel and aluminum). This will demonstrate that we are verging on clear design methods for impact welding that considers all important aspects from equipment design to component performance. This will be applied to the prototype manufacturing of advanced automotive components including a multi-material engine cradle. Beyond welding, these methods can be used for effective ‘joining by forming’ and modifying and reducing residual stress. Guidelines on process capabilities and selection will be provided and opportunities for further research will be discussed.

About Professor Glenn S. Daehn

Glenn S. Daehn is The Mars G. Fontana Professor of Metallurgical Engineering in the Department of Materials Science and Engineering at The Ohio State University. He works in several areas including process innovation and K-12 STEM professional development; providing materials science content and training. His formal training includes a PhD in Materials Science and Engineering from Stanford University and a B.S. from Northwestern University. Most of his current process innovation work is in developing impulse-based manufacturing processes for the joining, shaping and cutting of material. Details are available at <http://iml.osu.edu>. Prof. Daehn is also active in many manufacturing initiatives, having a hand in founding the LIFT Manufacturing USA institute, Ohio State's Center for Design and Manufacturing Excellence and Ohio Manufacturing Institute. He also serves on the Executive Committee for MFOresight and is Vice Chair of the ASM Materials Education Foundation.





Symposium Invited Speaker - III

Sponsored by the ASME Manufacturing Engineering Division's Biomanufacturing Technical Committee

Date & Time: Wed., June 20th, 11am - 12:30pm, Room 103 (see MSEC2018 Technical Program for details)

“3D Printing Technology and Its Biomedical Applications”

Professor Dong-Woo Cho

Center for rapid prototyping based 3D tissue/organ printing, Department of Mechanical Engineering
POSTECH, Korea

Abstract

The research at the Intelligent Manufacturing Systems (IMS) Laboratory is focused in the application of 3D printing technology to the field of biomedical engineering by fabricating complex 3D structures. Specifically, in the IMS laboratory, the 3D printing technology lies at the basis of the research for in vivo tissue regeneration and the development of ex vivo tissue/organ model that relate to the big picture of tissue engineering and regenerative medicine. To begin, the extrusion-based 3D printing technology allows for the precise fabrication of 3D scaffolds up to micro-meter scales. The automated design and fabrication system used along with the 3D printing makes possible the fabrication of patient-specific 3D scaffold with on-going clinical applications at the patient's site of defect. Beyond the fabrication of 3D scaffolds, the IMS laboratory has developed a 3D cell/tissue printing technology for the fabrication of live scaffolds of which the integrated pre-tissues can be fabricated in a single step with the use of multiple types of cells and biological materials. In addition, the laboratory has also developed tissue- and organ- derived extracellular matrix bioink that would optimize the mimicry of the native tissue's biochemical microenvironments and enhance pre-tissues functionalities. Currently, based on the previously mentioned technologies, the IMS laboratory is heading to develop both composite cell-based scaffolds for the treatment of areas of defects and hard-to-cure diseases and ex vivo tissue/organ models for discovery of new drugs and its safety assessment. The following presentation will demonstrate the role and significance of 3D printing in the biomedical field and provide us with a time for deep discussions on the aforementioned research topics.

About Professor Dong-Woo Cho

Prof. Dong-Woo Cho received his Ph.D. in Mechanical Engineering from the University of Wisconsin-Madison in 1986. Ever since, he has been a professor of Department of Mechanical Engineering at the Pohang University of Science and Technology. He is director of the Center for Rapid Prototyping-based 3D Tissue/Organ printing. His research interests include 3D microfabrication based on 3D Printing technology, its application to tissue engineering, and more generally to bio-related fabrication. He has recently focused on tissue/organ printing technology and development of high-performance bio-inks. He has received several prestigious awards in these academic areas. He serves or has served on the editorial boards of several International Journals. Prof. Cho has published over 260 academic papers in various international journals in the field of manufacturing and tissue engineering (>8,100 citations, h-index = 49), and has contributed chapters to ten books and written a textbook related to tissue engineering and organ printing.

