

ALMA Forum 2026

Abstracts of Presentations

14 November, 2026

Mito City Civic Center

Izumicho, Mito-city, Ibaraki, Japan

Japan Institute of Light Metals

ALMA Forum 2026

Program

Date: 14 November, 2026

Venue: Mito City Civic Center

(1-7-1, Izumicho, Mito-city, Ibaraki, Japan 310-0026)

Opening Ceremony

Chairperson: Prof. Ryoichi Ichino (Nagoya University, International Communication Committee of Japan Institute of Light Metals, Japan)

9:00 *Opening Address*

Prof. Kenji Matsuda (University of Toyama, Chair of ALMA and Chair of International Communication Committee of Japan Institute of Light Metals, Japan)

Session 1

Chairperson: Prof. Gaowu QIN (Northeastern University, China)

9:05 *Microstructure Control in Aluminium Alloys during Additive Friction Stir Deposition: the Role of $Al_3(Sc,Zr)$ Dispersoids*

Dr. Thomas Dorin (Institute for Frontier Materials, Deakin University, Australia)

9:35 *Enhanced strength-ductility synergy in Al-based metal-matrix-composites with controllable heterogeneous structures*

Prof. Fuping Yuan (Institute of Mechanics, Chinese Academy of Sciences, China)

10:05 *Thermal-rate driven phase transition of Fe-rich intermetallics in Al-Si-Mg casting alloys*

Dr. Young-Hee Cho (Lightweight Materials Research Division, Korea Institute of Materials Science, Korea)

10:35 Coffee Break (10:35-10:45)

Session 2

Chairperson: Jung Gi Kim (Gyeongsang National University, Korea)

10:45 *Precipitation and Kinetics of Pre-ageing and Paint-baked Ageing of Naturally-aged Al-Mg-Si-Cu aluminium alloys*

Assist. Prof. Tsai-Fu Chung (National Yang Ming Chiao Tung University, Taiwan)

- 11:15 *Research Project on Recycling of Aluminum at University of Toyama*
Prof. Toshiya Shibayanagi (Aluminum Research Center, University of Toyama, Japan)
- 11:45 *Microstructure-Informed Design of Additively Manufactured Alloys and Architected Materials*
Dr. Olga Zinovieva (University of New South Wales, Australia)
- 12:15 Lunch (12:15-13:15)
 Lunch (12:15-13:15) & Only delegates from overseas can attend the 151st conference of JILM Poster Session (13:15-15:10)

Session 3

- Chairperson: Dr. Olga Zinovieva (University of New South Wales, Australia)*
- 15:10 *AI driven rational design of new aluminum alloys*
Prof. Gaowu Qin (Northeastern University, China)
- 15:40 *Post-heat treatment effects on the mechanical properties of additively manufactured Ti-6Al-4V alloy*
Assoc. Prof. Jung Gi Kim (Gyeongsang National University, Korea)
- 16:10 *Lightweight Syntactic Foams Based on Recycled Aluminum and Magnesium Alloys: Microstructure and Energy Absorption Behavior*
Assoc. Prof. Yu-Chih Tzeng (National Central University, Taiwan)
- 16:40 *Circular Economy Initiatives and Strategies of the Aluminium Industries in Japan*
Yasushi Noto (Executive Director of Japan Aluminium Association, Japan)

Closing Ceremony

- Chairperson: Prof. Kenji Matsuda (University of Toyama, Chair of the International Communication Committee of Japan Institute of Light Metals, Japan)*
- 17:20 *Honoring Ceremony and Group Photo*
- 17:50 *Closing Address*
Prof. Takumi Haruna (Kansai University, Vice Chair of the International Communication Committee of Japan Institute of Light Metals, Japan)
- 18:00 Join the members social gathering party of the 151st Conference of Japan Institute of Light Metals

Dr Thomas Dorin

Associate Professor, Materials Characterisation, Institute for Frontier Materials,

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Dr Thomas Dorin is Associate Professor in Materials Characterisation at the Institute for Frontier Materials, Deakin University, Australia. He leads research in physical metallurgy, with a particular focus on aluminium alloys, precipitation phenomena, solid-state processing and advanced microstructural characterisation. His work combines alloy design, thermomechanical processing and high-resolution characterisation techniques, including transmission electron microscopy, atom probe tomography and small-angle X-ray and neutron scattering.

Dr Dorin received his PhD in materials science from Grenoble University, France, in 2013, before joining Deakin University in 2014. Since then, he has developed a research program focused on the design and processing of advanced aluminium alloys, with particular expertise in scandium-containing aluminium alloys and, more recently, recycled aluminium systems. A major focus of his current research is the development of alloy strategies for Additive Friction Stir Deposition, a solid-state additive manufacturing process with strong potential for producing high-performance aluminium components at large scale.

His research group investigates how alloy composition and processing conditions control precipitation, recrystallisation and mechanical properties in aluminium alloys. Recent work has focused on the stability of $L_{12}Al_3(Sc,Zr)$ core-shell dispersoids during severe thermomechanical processing, and on their role in grain refinement, recrystallisation control and strengthening. This research builds on long-standing international collaborations, including six-month sabbaticals at the University of Manchester in 2019 and the University of Rouen in 2025. Dr Dorin also initiated a cotutelle PhD program between Deakin University and INSA Lyon, France, which has already produced four PhD graduates.

Dr Dorin is actively involved in industry-facing research on light metals, with past and ongoing collaborations involving major aluminium producers and end users, including Universal Alloy Corporation, Constellium, Novelis, Rio Tinto, Sunrise Energy Metals, Australian Mines, Boeing, Air Radiators and Baosteel Packaging.

Microstructure Control in Aluminium Alloys during Additive Friction Stir Deposition: the Role of $\text{Al}_3(\text{Sc,Zr})$ Dispersoids

Thomas Dorin

Institute for Frontier Materials, Deakin University, Australia

Additive Friction Stir Deposition (AFSD) is emerging as a promising solid-state additive manufacturing process for large-scale manufacture of aluminium components. During AFSD, the feedstock bar is fed through a rotating tool over a substrate, generating heat until the metal softens sufficiently to flow and be deposited through translation of the tool, without ever melting. By avoiding melting and solidification, AFSD reduces key issues associated with fusion-based processes, including porosity and hot cracking. However, most high-strength aluminium alloys rely on precipitation heat treatments that may be impractical for large-scale deposited components. Solute-strengthened alloys, such as 5xxx series aluminium alloys, are more readily compatible with an as-deposited manufacturing route, but their achievable strength remains limited. In this context, thermally stable, pre-existing precipitates offer an attractive route to combine scalable manufacturing with improved microstructure and mechanical properties.

This presentation will discuss recent work on Al-Mg and Al-Mg-Sc-Zr alloys processed by AFSD, with a focus on thermally stable, core-shell L_{12} $\text{Al}_3(\text{Sc,Zr})$ dispersoids. These nanoscale precipitates are coherent with the aluminium matrix and effective at controlling recrystallisation and grain growth. In Al-Mg-Sc-Zr alloys, pre-existing $\text{Al}_3(\text{Sc,Zr})$ dispersoids were shown to strongly affect the final deposited microstructure, promoting a fine and homogeneous grain structure through Zener pinning and suppression of static recrystallisation. This contrasts with the behaviour of a comparable Al-Mg alloy, where more pronounced grain coarsening and recrystallisation heterogeneity were observed.

The talk will also examine the stability of $\text{Al}_3(\text{Sc,Zr})$ dispersoids under the extreme local conditions imposed by AFSD. Transmission electron microscopy reveals that the dispersoids can survive deposition but may also coarsen, partially dissolve, shear or rotate relative to the matrix depending on the local deformation and temperature history. Recent high-resolution microscopy work, including analysis of precipitate/matrix rotations, suggests that AFSD can drive precipitates into unusual semi-coherent configurations that are not typically observed after conventional heat treatments.

The results show that thermally stable $\text{Al}_3(\text{Sc,Zr})$ dispersoids provide a powerful tool to design stronger aluminium alloys specifically for large-scale solid-state additive manufacturing, while limiting the reliance on post-deposition heat treatment.

Fuping Yuan

Professor at State Key Laboratory of Nonlinear Mechanics, Institute of Mechanics, Chinese Academy of Sciences, Beijing 100190, China

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Dr. Fuping Yuan (F. P. YUAN) is currently a full professor of Institute of Mechanics, Chinese Academy of Sciences. He is now the Vice Director of State Key Laboratory of Nonlinear Mechanics, and the Vice Director of department of solid mechanics in University of Chinese Academy of Sciences.

His research fields focus on the mechanical behaviors of advanced metals and alloys and the impact dynamics. He has published over 130 SCI-indexed papers in prestigious journals such as Nature, Nature Materials, PNAS, Nature Communications, Acta Materialia. His work has received nearly 10,000 citations. He holds more than 10 authorized invention patents.

He has been honored as a Leading Talent in Scientific and Technological Innovation under the WR Program, a recipient of the National Science Fund for Excellent Young Scholars, and a winner of the CAS Lu Jiaxi Youth Talent Award.

Enhanced strength-ductility synergy in Al-based metal-matrix-composites with controllable heterogeneous structures

Fuping YUAN

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Al-based metal-matrix-composites have great potentials in aerospace applications due to their high specific stiffness and high specific strength. However, the trade-off between strength and ductility is the bottleneck, their low ductility and low toughness limit their practical applications.

This talk reviews the recent development of Al-based metal-matrix-composites. The strengthening and toughening are realized in Al-based metal-matrix-composites by applying heterogeneous structures. The strength and the ductility are much improved by optimizing the microstructure parameters through coupled CPFEM-PF simulations and machine-learning methods. The extra hardening and strengthening mechanisms are revealed, which provides a pathway for real applications of Al-based metal-matrix-composites.

Young-Hee Cho

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Dr. Young-Hee Cho is a distinguished expert in the field of aluminum casting alloys, with a career spanning over two decades dedicated to advancing solidification, casting and alloy design. She received her Ph.D. in Materials Science and Engineering from Seoul National University, Korea in 2008. Following her doctoral studies, she conducted advanced research as a postdoctoral research fellow at the University of Queensland, Australia, from 2008 to 2011. She joined Korea Institute of Materials Science (KIMS) in 2011, where she currently serves as a mid-career academic leader and researcher.

Since joining KIMS, Dr. Cho has carried out the development of original technologies for high-performance aluminum alloy design based on solidification behavior and microstructure control. Her research excellence is evidenced by more than 77 publications in SCI journals. She has also secured technological competitiveness by registering approximately 20 core domestic and international patents.

Her recent research focus addresses the critical challenges of the modern casting industry, particularly in the context of the low-carbon circular economy. Her key projects include (i) Eco-friendly recycling: Development of recycling technologies for high Fe content aluminum casting alloys to promote sustainability; (ii) High performance alloys: Engineering advanced aluminum alloys with breakthrough strength-ductility-conductivity trade-offs and (iii) Mobility innovations: Contributing to the lightweighting of next-generation mobility and the localization of core materials, driving national advancements in light metal technologies.

Dr. Cho currently serves as a general secretary of the Aluminum Division of the Korea Institute of Metals and Materials (KIM) and is a member of the board of Korea Foundry Society.

Thermal-rate driven phase transition of Fe-rich intermetallics in Al-Si-Mg casting alloys

Hyun-Seok Cheon^{a,b}, Su-Hyeon Kim^a, Hyeon-Woo Son^a, Seung-Uk Lee^a, Kwangjun Euh^a, Je In Lee^b, Young-Hee Cho^{a,†}

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As the demand for sustainable manufacturing grows, the recycling of aluminum casting alloys has become essential. However, a critical challenge in utilizing secondary aluminum is the accumulation of Fe impurities, which promote the formation of brittle, plate-like β -Al₅FeSi intermetallic compounds. In this study, we systematically investigated the role of melt thermal history in governing Fe-rich phase transitions in an A356 (Al-7Si-0.35Mg) alloy containing 0.4 wt.% Fe. We employed thermal-rate treatment (TRT), which involves superheating the melt to 800 °C for 60 minutes prior to solidification. To understand the coupling between liquid-state conditions and solidification kinetics, controlled cooling conditions were applied, ranging from gravity casting to rapid solidification via melt spinning. The results demonstrate that TRT effectively suppresses the formation of monoclinic β -Al₅FeSi and promotes the crystallization of the metastable cubic α -AlFeSi phase with a favorable Chinese-script morphology. To elucidate the underlying mechanism, transmission electron microscopy (TEM) and atom probe tomography (APT) were utilized to characterize the as-quenched liquid-state configurations. APT analysis provided atomic-scale evidence that TRT alters the nanoscale distribution of Fe and Si by suppressing solute clustering and promoting a more homogeneous solute configuration in the melt. Partial radial distribution function analysis showed a pronounced reduction in Fe-Si correlations, indicating a significant weakening of the chemical short-range order in the liquid state. This modified liquid structure facilitates the preferential nucleation of α -AlFeSi and kinetically inhibits the peritectic transformation from α -AlFeSi to β -Al₅FeSi during subsequent solidification. This work suggests a promising physical pathway to upgrade recycled aluminum alloys by engineering the hereditary link between the liquid and solid states.

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Tsai-Fu Chung

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I am an Assistant Professor in the Department of Materials Science and Engineering at National Yang Ming Chiao Tung University. I received my Ph.D. in Materials Science and Engineering from National Taiwan University in 2019. To broaden my research horizons, I have served as a researcher at world-renowned institutes, including the European Synchrotron Radiation Facility (ESRF) in France and the National Institute for Materials Science (NIMS) in Japan. My academic focus centers on the physical metallurgy of advanced structural materials, driving innovations in alloy design and processing through deep microstructural insights. I am honored to have received multiple academic accolades, including the 2025 Young Scholar Award from the Taiwan Society for Heat Treatment and the 2020 Ministry of Science and Technology Postdoctoral Researcher Academic Achievement Award.

Professional Capabilities

My core expertise bridges state-of-the-art microstructural characterization with rigorous mechanical performance evaluations:

- **Atomic-Level Characterization:** Proficient in utilizing spherical aberration-corrected electron microscopy (Cs-corrected HAADF STEM) and 4D STEM for atomic microstructure analysis and interfacial strain mapping.
- **Quantitative Synchrotron Analysis:** Highly experienced in employing Taiwan Synchrotron Small-Angle X-ray Scattering (SAXS) and 3D Projection X-ray (PXM) to quantitatively evaluate nanoscale precipitates and their 3D morphologies.
- **Dynamic and Extreme Environment Testing:** Specialized in high strain rate mechanical testing (up to 9000 s^{-1}) utilizing Hopkinson tensile and impact analysis. Furthermore, I conduct mechanical property testing under extreme environmental conditions,

encompassing high temperatures (1000°C), cryogenic conditions (-100°C), and highly corrosive environments.

Industrial Aluminum Alloy Cases and Projects

A significant portion of my research involves the strategic development and characterization of lightweight aluminum alloys for aerospace and automotive applications, often supported by industry collaborations (such as Foxconn) and government grants. Key project achievements include:

- **7000 Series (Al-Zn-Mg-Cu) High-Strength Alloys:** Served as the Principal Investigator for projects aimed at establishing a materials database that correlates multi-morphology nano-precipitates from rapid-aging heat treatments with tensile strength and stress corrosion resistance. My fundamental research on these alloys includes groundbreaking in-situ atomic-scale analysis capturing the separated nucleation mechanism of GPII zones transitioning to η' precipitates, and the in-situ nucleation mechanism from η' to η .
- **6000 Series (Al-Mg-Si-Cu) Automotive Body Panels:** Led an industry-academia collaborative project focusing on improving the performance of bake-hardenable 6061 aluminum alloys via multi-stage non-isothermal pre-aging treatments. This work utilized synchrotron radiation and high-resolution electron microscopy to deeply monitor precipitation behavior and establish reliable heat treatment-performance relationships for industrial applications.
- **2000 Series (Al-Cu-Li & Al-Cu-Mg-Ag) Aerospace Alloys:** Conducted extensive characterization combining SAXS and HRSTEM to quantitatively analyze the relationship between precipitate evolution and mechanical performance in Al-Cu-Mg-Ag systems. Additionally, I have investigated the intricate interactions between dislocations and precipitates in advanced Al-Cu-Li alloys.

Precipitation and Kinetics of Pre-ageing and Paint-baked Ageing of Naturally-aged Al-Mg-Si-Cu aluminium alloys

Tsai-Fu Chung

Department of Materials Science and Engineering, National Yang Ming Chiao Tung University, Hsinchu, Taiwan.

AA6061 (Al-Mg-Si-Cu) aluminum alloys have emerged as the preferred material for lightweight automobile body panels due to their robust short-term artificial ageing capabilities. However, extended inventory holding periods and delivery times have exacerbated the negative impact of prolonged natural ageing on the paint-baked hardness response. While pre-ageing treatments are claimed to resolve this issue, quantitative characterization evaluating the combined effects of pre-ageing and paint-baked ageing on precipitate formation remains limited.

In this work, we investigate paint-baked Al-Mg-Si-Cu alloys that were first subjected to a pre-ageing treatment at 80°C for 1 hour, followed by prolonged secondary natural ageing at 25°C for 30 days. The microstructural evolution of the precipitates during the paint-baking process (aged at 180°C for 1, 2, and 3 hours) was systematically characterized using transmission electron microscopy (TEM). Complementing the TEM observations, in-situ heating small-angle X-ray scattering (SAXS) was utilized to analyze the precipitation kinetics, paving the way for tailoring the mechanical properties of these alloys.

Toshiya Shibayanagi

Professor Emeritus, Aluminum Research Center,
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Director of International Institute of Light Metals (ILM)

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Professor Shibayanagi began his academic career at the School of Engineering, Osaka University, where he investigated the relationship between grain boundary structures and grain boundary properties in aluminum, copper, copper–zinc alloys, silicon steel sheets, and intermetallic compounds. In his studies on grain growth in aluminum, he demonstrated—through both experimental approaches and numerical simulations—that spatial heterogeneity in grain boundary structures exerts a significant influence on microstructural evolution.

At the Joining and Welding Research Institute of Osaka University, he conducted research on metal–ceramic brazing, diffusion bonding of ceramics, nano-grain structure produced by rapid cooling and friction stir welding (FSW). After moving to the University of Toyama, he developed a visualization system for plastic flow during FSW, elucidated abnormal grain growth in FSW materials, and independently invented the disk friction joining (DFJ) method, achieving successful joining of aluminum with titanium and polymer materials.

Professor Shibayanagi has also held several major leadership positions at the University of Toyama, including Vice Dean of the Faculty of Engineering, Deputy Director for Research Promotion, Director of the Industry–Academia Collaboration Center, Assistant to the President, and Director of the International Advanced Aluminum Research Center. Most recently, he has served as the leader of a national project on aluminum recycling, with a total budget of 3 billion yen.

Research Project on Recycling of Aluminum at University of Toyama

Toshiya Shibayanagi

Aluminum Research Center, University of Toyama

1. Recycling of Aluminum

Aluminum requires huge amount of electric energy during smelting from ore called bauxite, exhausting carbon dioxide for about ten times of its weight. This reclaims that this metal has a large impact on the environment much more than iron. Since some area or nations are sensitive to this environmental issue in industries, aluminum industries in Japan are now facing to a critical situation or a threat that any products should be given penalty upon exporting to those area in the near future. Thus, we should reduce carbon dioxide in the production system of aluminum, and “recycling from scraps” is now a key to this issue.

2. Aluminum Research Center (ARC)

University of Toyama has established Aluminum Research Center (ARC) in 2022, and also established International Institute of Light Metals (ILM) in collaboration with Magnesium Research Center (MRC) in Kumamoto University. In 2023, ARC constructed a building specially designed for promoting research works on recycling of aluminum. It is equipped with a refining furnace specially designed for removal of impurities such as Si and Fe. In addition, it has a large-scale extruding machine with 400MTon, scanning transmission electron microscope, EPMA, laser surface treatment system, disc friction joining machine and some other welding machines, etc. A DX server with a special *AI* system is also installed in this building and is on the way to further development to realize a kind of DPP system on Aluminum in Japan.

3. National Project on Aluminum Recycling

3.1 Removal of impurities

Recycling of aluminum is a kind of “subtraction in alloy design”, which is on the opposite concept of the conventional alloying such as “addition in alloy design”. Since many kinds of scraps are gathered and come into the recycling process, removal of elements or impurities are quite important part of the process. As strong affinity exists between

aluminum and other elements, aluminum is hard to be refined by oxidation of the impurities. But, our project found a novel principle utilizing a difference in solubility of each element in molten tin, which has been established by professors H.Ono and K.Kato. So far, we have successfully realized that both Si and Fe are removed via “tin bath process” from Al-Si alloy, called ADC12.

3.2 Finding negative elements in recycled aluminum alloys

The recycled aluminum alloy contains mixture of elements such as Si, Fe, Mn, Cu, and so on., depending on the starting scraps. Unfortunately, we don't have enough information on such complex, so we need to investigate the effect of each impurity on the properties of recycled aluminum alloys one by one. Prof. K.Matsuda and his group have found some elements deteriorate hardness while some are not. These “negative elements” are the targets to be removed or neutralized, and the group also found some elements for this use.

The following parts such as extrusion by Profs. T.Shiatori and T.Funazuka, a laser surface treatment by Prof. A.Saiki, and welding by Prof. T.Shibayanagi also have achieved results that contribute to the advancement of recycling processes. In addition, unique sorting technologies have been developed by Prof. C.Tokoro from Waseda University, and Profs. T.Hiraki from Tohoku University and M.Murayama from Kansai University are focusing on the new processing of dross.

3.3 Traceability of recycling process for digital product passport

The present project aims to produce a digital certificate which helps companies to increase the environmental value of their products. An artificial intelligence (AI) is also under development. Finally, a certificate demonstrating economic feasibility will be issued.

4. Summary

The present “COI-NEXT” project has been supported by Japan Science and Technology Agency (JST) since 2024. We sincerely hope that this decade-long project will bring about fruitful technologies for aluminum industries in Japan.

Olga Zinovieva

Senior Lecturer and Australian Research Council Discovery Early Career Researcher Award (DECRA) Fellow at School of Engineering and Technology, UNSW Canberra, University of New South Wales (UNSW)

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Dr Olga Zinovieva received her PhD degree from Tomsk State University, Russia. Currently she is an Australian Research Council DECRA Fellow and Senior Lecturer in Mechanical Engineering in the School of Engineering and Technology at the University of New South Wales (UNSW), UNSW Canberra, Australia. She joined UNSW Canberra in 2022 as a Lecturer and has since contributed to teaching, research, and academic leadership in mechanical engineering.

Before joining UNSW, Dr Zinovieva worked at the Airbus Endowed Chair for Integrative Simulation and Engineering of Materials and Processes at the University of Bremen, Germany. She has also held visiting positions at UNSW Canberra, the University of Bremen, Sao Paulo State University in Brazil, and the Centre of Materials, Mines ParisTech in France.

Dr Zinovieva contributes actively to professional and academic communities. She is a member of the Australian Materials Research Society, Women in High Performance Computing, and Materials Australia, where she is recognised as a Certified Materials Professional. Dr Zinovieva also serves as the ACT representative on the National Awards Committee of Materials Australia. She is a Junior Editorial Board Member of the Journal of Materials Informatics and a Topical Advisory Panel Member of Metals. She has also served as a Guest Editor for a special issue of Metals on microstructure and properties of metallic materials produced by additive manufacturing.

Her research field involves additive manufacturing, digital engineering, mechanics of materials, impact dynamics, and integrated computational materials engineering. Her current research focuses on processing, microstructure, and property relationships in additive manufacturing. A key aim of her work is to transfer knowledge from computational and experimental research into practical engineering applications, particularly in advanced manufacturing and materials design.

Microstructure-Informed Design of Additively Manufactured Alloys and Architected Materials

Olga Zinovieva

University of New South Wales (UNSW), UNSW Canberra

Additive manufacturing offers unique opportunities to design metallic materials and components with tailored composition, geometry, and microstructure. However, the performance of additively manufactured parts is strongly affected by local thermal history, solidification conditions, defect formation, and geometry-dependent material behaviour.

This work presents a microstructure-informed approach to the design and assessment of additively manufactured alloys and architected materials. The approach combines process modelling, microstructure simulation, experimental characterisation, and mechanical performance analysis to link processing conditions with microstructure development and structural response.

The approach is demonstrated through two complementary case studies. The first focuses on additively manufactured alloys produced by laser powder bed fusion, including aluminium and titanium alloys. Thermal simulations, microstructure modelling and mechanical simulations are used together with experimental observations to understand the process-structure-property relationships. The second case study investigates powder bed fusion electron beam manufactured Ti6Al4V ELI microlattices under low-velocity impact loading. BCC and BCCz lattice architectures with varied unit cell parameters, aspect ratios, and relative densities are analysed to determine how geometry and strut-level material behaviour affect deformation, failure initiation and progression, stiffness, strength, and energy absorption.

This work highlights the need to integrate microstructure evolution into the design of additively manufactured materials and structures. By linking process, microstructure, and performance, microstructure-informed design provides a pathway for developing high-performance alloys and architected materials for demanding applications.

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Dr. Gaowu QIN (G. W. QIN) is currently a full professor of materials science, president of Shenyang University of Chemical Technology, and part-time professor at Northeastern University, China. He received both his B. E. degree in 1992 and Ph. D. degree in 1998 in materials science from Northeastern University, China.

At the beginning of 1999, he worked at Oxford University as a visiting scholar, and then moved to AIST and Tohoku University, Japan, respectively, as JSPS post-doctor and guest research fellow for seven years. In 2006, Dr. Qin joined Northeastern University as a full professor, and then moved to Shenyang University of Chemical Technology as vice-President in 2024 and President in 2026. He is now the member of the materials discipline review group of the Academic Degrees Committee of the State Council, vice-chairman of Chinese Society for Stereology, executive director of Chinese Materials Research Society, vice-chairman of functional materials branch of the Chinese Society for Metals, editorial board members of JMST and Rare Metals international journals.

Prof. Qin's main research topics are light metal structural materials and their functionalization, involving Al alloys, Mg alloys, Mg-base biomaterials and Al/Mg/Ti-base catalysts. He has published more than 400 SCI indexed and peer-reviewed papers in Nature, Physical Review Letters, Acta Materialia and so on, obtained more than 40 granted invention patents, and won the first prize of the S&T award of China Nonferrous Metals Association. Prof. Qin was selected as the winner of the National Science Foundation for Distinguished Young Scholars.

AI driven rational design of new aluminum alloys

Gaowu QIN

Shenyang University of Chemical Technology, Shenyang 110142, China
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Shenyang 110819, China

Lightweighting of equipment is an inevitable trend in the development of current and future energy-conserving societies. As a lightweight metallic structural material, aluminum alloys have broad application prospects in equipment lightweighting across fields such as automobiles, high-speed railways, and aerospace. The pursuit of high strength and high ductility in aluminum alloys has always been a core research topic for materials scientists and engineers, and progress in this area largely depends on the research experience of individual investigators.

With the deepening transition toward green manufacturing, recycled aluminum is gradually becoming the primary source of raw material for aluminum alloy production. However, precise control of iron content in recycled scrap aluminum has emerged as a key technical bottleneck restricting the high-performance utilization of recycled aluminum alloys. Traditional "trial-and-error" research paradigms struggle to achieve precise synergistic control over "composition design—heat treatment process—comprehensive mechanical properties" within high-dimensional compositional spaces.

To address this challenge, this report takes commonly used 6xxx series aluminum alloys as an example, adopts data-driven machine learning as the core methodology, and, across four dimensions—dataset construction, model prediction, alloy design, and analysis of elemental rules—develops an intelligent and efficient research method and software suite for 6xxx series aluminum alloys.

Jung Gi Kim

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Prof. Jung Gi Kim received his Ph.D. from the Pohang University of Science and Technology (POSTECH). He was a postdoctoral researcher at the Center for Advanced Aerospace Materials at POSTECH and at the Max Planck Institute for Iron Research from 2018 to 2019. He is currently a faculty member in the Department of Materials Engineering and Convergence Technology at Gyeongsang National University.

He dedicates himself to several institutes in the Republic of Korea: the Korean Institute of Metals and Materials (Councilor), the Korean Society for Technology of Plasticity and Materials Processing (Director), and the Korean Powder Metallurgy & Materials Institute (Steward). He was awarded the Emerging Scholar Award by the Korean Institute of Metals and Materials (April 2025) and the Emerging Technology Award by the Korean Society for Technology of Plasticity and Materials Processing (November 2025).

His research focuses on additive manufacturing of metallic materials and dissimilar welding for aerospace applications. He aims to achieve defect-free, high-strength additively manufactured components by optimizing processing parameters through database analysis and by adjusting microalloying elements in pre-alloyed powders.

Post-heat treatment effects on the mechanical properties of additively manufactured Ti-6Al-4V alloy

Jung Gi Kim

Department of Materials Engineering and Convergence Technology,
Gyeongsang National University, Jinju, Republic of Korea

Post-heat treatment of additively manufactured metallic components is critical for achieving reliable mechanical properties; however, the effects of post-heat treatment conditions on the microstructural evolution and mechanical properties of additively manufactured Ti-6Al-4V alloy are not yet fully understood.

Therefore, this presentation investigates the influence of post-heat treatment on the mechanical properties—specifically tensile strength and fatigue crack propagation—of a directed energy deposited Ti-6Al-4V alloy. Depending on the post-heat treatment temperature, microstructural changes such as lath growth, local misorientation relief, and prior β grain transformation occur, contributing to a reduction in strength and an increase in ductility during tensile testing. Additionally, the tensile test temperature affects the slip system activity in the directed energy deposited Ti-6Al-4V alloy, resulting in varying activation of prismatic and basal slip systems at different temperatures.

Although post-heat treatment significantly influences the tensile properties of the additively manufactured Ti-6Al-4V alloy, fatigue crack propagation resistance shows little variation due to rapid crack growth through the fine lath structure. This study demonstrates that while post-heat treatment is important for optimizing quasi-static mechanical properties, overcoming the poor dynamic performance remains a challenge, which is critical for the long-term application of these components.

Yu-Chih Tzeng

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Dr. Yu-Chih Tzeng is an Associate Professor in the Department of Mechanical Engineering at National Central University, Taiwan. He received his Ph.D. in Mechanical Engineering from National Central University in 2016. Prior to joining National Central University, he served as a faculty member at the Chung-Cheng Institute of Technology, National Defense University, following more than two decades of military service.

Dr. Tzeng's research focuses on physical metallurgy and advanced metallic materials, particularly aluminum alloys, magnesium alloys, and lightweight structural metals. His work investigates the processing–microstructure–property relationships of metallic materials through thermomechanical processing, microstructural characterization, and mechanical property evaluation.

His research focuses on physical metallurgy and advanced metallic materials, particularly aluminum and magnesium alloys, lightweight structural metals, and metal matrix syntactic foams. His work explores the processing–microstructure–property relationships of metallic materials and the development of lightweight energy-absorbing structures. With his background in defense engineering, his research also involves the development of lightweight metallic materials and energy-absorbing structures for protective and defense-related applications.

Lightweight Syntactic Foams Based on Recycled Aluminum and Magnesium Alloys: Microstructure and Energy Absorption Behavior

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Lightweight metal matrix syntactic foams (MMSFs) derive their mechanical response from the coupled effects of porous architecture, interfacial reactions, and matrix-specific strengthening mechanisms. However, the underlying deformation mechanisms across different alloy systems remain insufficiently understood.

In this study, syntactic foams based on Al–Cu–Mg–Ag and WE43 magnesium alloys were developed using hollow metallic spheres to elucidate matrix-dependent deformation behavior. In the aluminum-based system, TEM observations confirm that interfacial diffusion between the Al matrix and Fe-based fillers leads to the formation of Fe-rich intermetallic phases, including Al–Fe–Cu compounds. These intermetallic layers enhance interfacial load transfer in the early stage of deformation but introduce pronounced mechanical incompatibility, acting as preferential sites for crack initiation. Simultaneously, nanoscale precipitation within the Al matrix provides a dominant strengthening contribution, stabilizing plastic flow and enhancing the plateau response.

In contrast, the magnesium-based system is governed by interfacial reaction-driven phase evolution. EPMA analysis reveal the formation of Fe_{17}Y_2 and Mg_2Ni phases at the matrix–filler interface, resulting from strong elemental interdiffusion and solute segregation. These interfacial compounds induce a coupled strengthening–to–embrittlement transition, where enhanced bonding at low strains progressively gives way to strain localization and interface-assisted fracture at higher strains. The deformation behavior is further mediated by defect evolution and pore-architecture-controlled stress redistribution.

The results demonstrate that deformation in MMSFs is intrinsically matrix-dependent: aluminum-based systems are governed by precipitation strengthening and diffusion-induced intermetallic formation, whereas magnesium-based systems are dominated by interfacial reaction kinetics and defect-mediated deformation processes. This work establishes a mechanistic framework linking diffusion, interfacial phase stability, and deformation pathways, providing critical insights for the design of advanced lightweight energy-absorbing materials.

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Circular Economy Initiatives and Strategies of the Aluminium Industries in Japan

Yasushi Noto

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Although Japan classifies aluminum simply as a base metal, other major global economies designate it as a critical material. According to a report by the International Energy Agency (IEA), aluminum is positioned as a resource even more vital than rare earth elements or lithium for the future expansion of renewable energy. The United States specifically treats the aluminum industry as a crucial strategic sector, currently maintaining a 50% tariff. Similarly, Europe is considering export tariffs on aluminum scrap shipped outside the European Union. Japan currently depends entirely on imports for its primary aluminum supply. Consequently, promoting aluminum recycling is a matter of critical importance; it not only curbs carbon dioxide emissions to protect the environment but also mitigates foreign dependency and directly strengthens economic security. Meanwhile, the Japanese government's recently published "Basic Policy on Economic and Fiscal Management and Reform 2026" (commonly known as the "Honebuto") emphasizes the necessity of building a resilient economy and investing in crisis management. In alignment with this policy direction, I would like to discuss the strategic initiatives that the aluminum industry should pursue moving forward.