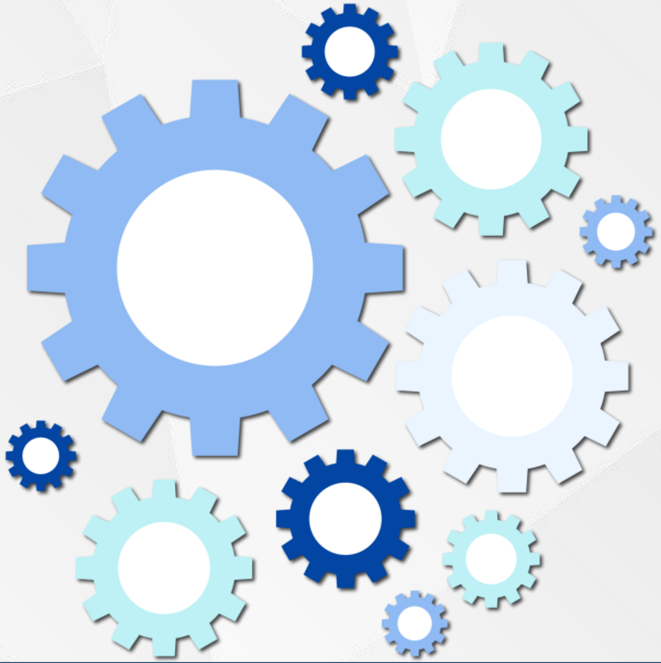
The 4th International Conference on Materials Science and Manufacturing Engineering (MSME 2021)

MSME 2021 Conference Programme



November 5, 2021 | Virtual Conference

Organized by

HKSME
HONG KONG SOCIETY OF MECHANICAL ENGINEERS

CONTENTS

01 WELCOME MESSAGE

Dear Participants,

The entire world is still under the influence of the virulent pandemic COVID-19. Unfortunately, each of us is affected one way or another. Our conference, the 4th International Conference on Materials Science and Manufacturing Engineering (MSME 2021) is not an exception.

To provide a safe conference environment and reduce people gathering, MSME 2021 which should be held in Beijing, China from November 5 to 7, 2021 as planned, is now changed as on-line conference. Changing the format however shall not affect the desire of the conference. We wish to continue our communication to share our new research ideas, discuss challenges and form collaborations to solve various issues on Materials Science and Manufacturing Engineering.

We would like to thank our outstanding Speakers: Prof. Ruxu Du from The Chinese University of Hong Kong, HKSAR, China; Prof. Alan Kin Tak Lau from Swinburne University of Technology, Australia and Prof. Zhengwei You from Donghua University, China for sharing their deep insights on future challenges and trends.

We would like to thank all the committees for their great support on organizing the conference. We also would like to thank all the reviewers for their great effort on reviewing the papers submitted to MSME 2021. Special thanks to all the researchers and students who with their work and participate in the conference.

While we may not see each other face-to-face in Beijing, we hope the conference can still establish a solid linkage among all the participant as desired. We look forward to your contribution to making MSME 2021 a success.

MSME 2021 Organizing Committee

02 CONFERENCE SPEAKERS

Prof. Alan Kin Tak Lau
(Keynote Speaker)

Swinburne University of Technology, Australia

Speech time: 9:10-9:50, Nov.5, 2021

Biography: Professor Alan Lau is Pro-Vice-Chancellor (Research Partnership and Digital Innovation) of Swinburne University of Technology. Professor Lau has received numerous research and teaching awards in the past 20 years. His published articles have received citations over 23,000 times (H-index 73) to date. In 2008, he was appointed World Class University Chair Professor by the Ministry of Education, Korea. He is Fellow of the European Academy of Science and Arts and a Fellow of many professional organizations. He was elected as International Vice President of the Institution of Mechanical Engineers (IMechE) from 2013 to 2019. In 2019, he was named as Australia's Research Theme Leader in Composite Materials. Since 2014, he was appointed Independent Non-Executive Director of King's Flair International (Holdings) Limited. Currently, he is Director of Oceania Cybersecurity Centre Ltd. And Stawell Underground Physics Laboratory Company.

02 CONFERENCE SPEAKERS

Prof. Alan Kin Tak Lau
(Keynote Speaker)

Swinburne University of Technology, Australia

Speech time: 9:10-9:50, Nov.5, 2021

Keynote Lecture: Aircraft Composite Repair - Fundamental to Structural Health Monitoring

Abstract: Advanced composites have been widely used in all engineering sectors owing to their high specific strength to weight ratio, non-corrosive properties and ease of manufacturing components in a piece without excessive use of fasteners that introduce additional weight and possibly, risks of generating corrosion with metallic components. Many practical examples have proved that the composites can be used in safe, in terms of their better fracture resistance characteristics. However, damage inspection and repair scheme for composites remain a critical issue for the aircraft engineering industry. Lacking knowledge of frontline technicians and engineers on these materials have always caused human errors in handling and fabricating composite components. Special environments and proper handling and manufacturing procedures should be followed to minimize the introduction of internal flaws, like voids and micro-cracks. Subsequent structural health monitoring and onsite damage detection are important to accurately identify flaws or damage that could not be seen from the surface of composite components.

In this seminar, Professor Lau will provide an overview on the applications of composites for different engineering sectors, as well as the key factors that affect the quality of composite repair, including the structural health monitoring of composites structures, after being repaired.

02 CONFERENCE SPEAKERS

Prof. Zhengwei You
(Keynote Speaker)

Donghua University, China

Speech time: 9:50-10:30, Nov.5, 2021

Biography: Dr. Zhengwei You is a full professor at the State Key Laboratory of Chemical Fibers & Polymer Materials and the Chair of the Department of Composite Materials at Donghua University. He received his degrees of B.S. (2000) from Shanghai Jiao Tong University and Ph.D. (2007) from Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences. From 2007 to 2012, he conducted his postdoctoral research on biomaterials at Georgia Institute of Technology and University of Pittsburgh. Prior to joining Donghua University in 2013, he was an innovation manager in Bayer MaterialScience. His current research involves smart polymers, elastomers, 3D printing, biomaterials, and stretchable electronics. He has published more than 70 peer-reviewed papers in the high impact journals (Among them, 27 papers have impact factor of more than 10), such as Nature Medicine, Nature Communication (2), Advanced Materials (2), Advanced Functional Materials (7), andapplied for more than 40 patents with 20 granted, and contributed one book chapter. His research has gotten funding support from various sides including National Natural Science Foundation of China, Ministry of Science and Technology of China, and the Department of Defense USA. He has delivered more than 50 invited lectures in international and national conferences.

He currently serves as the director of Research Base of Textile Materials for Flexible Electronics and Biomedical Applications, China Textile Engineering Society, associate editor of the journal Smart Materials in Medicine, editorial board member of the journal Bioactive Materials, youth editorial committee member of the journals Materials China and Advanced Fiber Materials. He is also a committee member of 3D printing technology branch of China Medicinal Biotech Association, Medical Biomaterials and Technology Professional Committee of China Medical Education Association, Biomanufacturing Engineering Branch of Chinese Mechanical Engineering Society, and Biomaterials Professional Committee of Shanghai Society of Biomedical Engineering.

02 CONFERENCE SPEAKERS

Prof. Zhengwei You
(Keynote Speaker)

Donghua University, China

Speech time: 9:50-10:30, Nov.5, 2021

Keynote Lecture: Biomimetic elastomers, 3D printing and their biomedical applications

Abstract: Aiming at the bottleneck problems that the widely used biomedical elastomers are difficult to mimic the mechanical and self-healing properties of natural tissues, and difficult to be processed, we have carried out systematic studies. A multi-bond interaction molecular mechanism of synergistic strong bonds and weak bonds has been proposed. Synergistic three mechanisms of "mechanically invisible" weak bonds and forming copper coordination bonds for strengthening and catalyzing the recombination of dynamic covalent bonds constructs a multi-bond hybrid cross-linking molecular network, which solves the conflict that high mechanical strength, low modulus, and self-healing are difficult to balance. This work provides a universal molecular design for the development of soft, strong, and self-healing bionic elastomers. A general molding strategy of "creating strength from weakness" in synergetic multi-bond systems is proposed. Utilization of the weak non-covalent interaction between food materials and polymers forms a strong covalently cross-linked network, which overcomes the difficulty of thermoset elastomers processing. Accordingly, a series of new medical devices with outstanding performance for tissue engineering and biomedical flexible electronics have been fabricated.

02 CONFERENCE SPEAKERS

Prof. Ruxu Du
(Keynote Speaker)

The Chinese University of Hong Kong, HKSAR, China

Speech time: 15:00-15:40, Nov.5, 2021

Biography: Dr. R. Du was born in China in 1955. He received his Master's degree from the South China University of Technology in 1983 and his Ph.D. degree from the University of Michigan in 1989. He has taught in the University of Windsor, in Windsor, Ontario, Canada (1991 1999), the University of Miami, in Coral Gables, Florida. USA (1999 2001), and the Chinese University of Hong Kong in Hong Kong SAR (2001 2018). He is also the founding director of the Guangzhou Chinese Academy of Sciences Institute of Advanced Technology (2011 2016). His areas of research include precision engineering, design and manufacturing (metal forming, machining, plastic injection molding and etc.), as well as robotics and automation. He has published over 450 papers in various academic journals and international conferences. He is the associate editor / the members of editorial board of six international journals. He has received a number of international and regional awards and recognitions, including: • Fellow of Canadian Academy of Engineering;
• Fellow of SME (Society of Manufacturing Engineers);
• Fellow of ASME (Society of American Mechanical Engineers);
• Fellow of HKIE (Hong Kong Institute of Engineers);
He has been happily married for 33 years and has two children, Jin and Ann. He enjoys Chinese poetry and tennis.

02 CONFERENCE SPEAKERS

Prof. Ruxu Du
(Keynote Speaker)

The Chinese University of Hong Kong, HKSAR, China

Speech time: 15:00-15:40, Nov.5, 2021

Keynote Lecture: Self-Guided Learning for Engineering Monitoring and Diagnosis

Abstract: Deep-learning is known to be able to capture complex patterns in big data and thus, make accurate detections as well as predictions for various engineering motoring and diagnosis tasks. However, it is dependent on the sufficient data from both normal and faulty conditions, which is often unavailable. This talk presents a novel self-guided learning method for engineering monitoring and diagnosis. The new method consists of three parts: The first part is a pre-processing. Analogy to human learning, it carries on the feature learning to capture key features of the data, as well as the contrastive learning to highlight the differences between normal and faulty conditions. The second part is to use Generative Adversary Network (GAN) to model the data. It helps to balance the data from both normal and faulty conditions. The third part is post-processing. It adds specific features, such as the patterns of wear and breakage, onto the data. Using robot condition monitoring and diagnosis as a practical example, it is shown the presented method outperforms the conventional CNN method. Moreover, only a few faulty condition data is required.

03 PRESENTATION GUIDE

Oral Presentation

1. File format: MS-PowerPoint (*.ppt) or Adobe PDF (*.pdf)
2. Time: About 15 mins, including Q/A time. Each presentation should have at least **12 minutes**.
3. Language: English
4. Fonts: Arial or Times New Roman
5. Dress code: Formal clothes
6. Facility: Presenters need to use own laptop, please notify conference secretary via e-mail in advance and test the connection before session start.

Poster Presentation

1. Poster Size: 1m*0.8m (height*width).
2. Language: English.
3. The poster should include: Paper ID, Conference Name's Acronym(MSME 2021), Significance of the research, the methods used, the main results obtained, and conclusions drawn.
4. Posters are required to be condensed and attractive.
5. The conference organizer won't send/keep any posters after the conference.

Note:

1. We'll record the whole conference. If you do mind, please inform us in advance. We'll stop to record when it's your turn to do the presentation.
2. The recording will be used for conference program and paper publication requirements. It cannot be distributed to or shared with anyone else, and it shall not be used for commercial nor illegal purpose.

Online Conference Software---VooV Meeting(腾讯会议)

Download link:

A) Chinese version

https://meeting.tencent.com/download-mac.html?from=1001&fromSource=1 (Mac OS)

https://meeting.tencent.com/download-win.html?from=1001&fromSource=1 (Windows)

B) International Version

https://voovmeeting.com/download/darwin（Mac OS）

https://voovmeeting.com/download/windows （Windows）

Conference Information:

Conference Time: 9:00-16:00, BJT, GMT+8, Nov.5, 2021

Conference Room ID: 167 248 058

Conference Link: https://meeting.tencent.com/dm/RGCwdidlMiB0

Note:

1. Please rename your name to your paper ID-Name (e.g. C001-Coral) when you join the online room;
2. Suggest to change your virtual background to conference background.
3. Please wear headphones during the conference.
4. Session Chair will call the roll 10 minutes before the session, please join the conference in advance for at least 10-15 minutes.
6. If you have any questions, please hands up or unmute your microphone directly or send you questions to the Chat box.
7. We will take a group photo and announce the best presenter after all the presentations this session.

Nov. 5, 2021 Friday | Beijing time, GMT+8 | Room ID: 167 248 058		
9:00-9:10	Opening Remark	
9:10-9:50	Keynote Lecture 1	**Aircraft Composite Repair - Fundamental to Structural Health Monitoring** Prof. Alan Kin Tak Lau, Swinburne University of Technology, Australia
9:50-10:30	Keynote Lecture 2	**Biomimetic elastomers, 3D printing and their biomedical applications** Prof. Zhengwei You, Donghua University, China
10:30-12:30	Technical Session	M002;M003;M004;M005;M1001;M1002;M1004;M006
	Lunch	
15:00-15:40	Keynote Lecture 3	**Self-Guided Learning for Engineering Monitoring and Diagnosis** Prof. Ruxu Du, The Chinese University of Hong Kong, HKSAR, China
15:40-16:00	Poster Session	M007;M1003;M001;M1009

Technical Session
Session Chair: Weizhao Zhang
10:30-12:30, Nov. 5, Friday | Room ID: 167 248 058

M002 **10:30-10:45**	**Fabrication of Titanium Coatings for Medical Device Applications** ***Hong ZHOU,*** Waikato Institute of Technology, New Zealand Abstract: Titanium is widely used for medical purposes. It related to bone repair because of its favorable mechanical properties and biocompatible ability to osseointegrate in host bone tissue. A good and lasting connection of the implant with the bone tissue is possible when there are sufficient conditions for the bone to grow into the pores of the material, therefore the use of a porous titanium coating may be helpful in solving this problem. In this paper, shrouded plasma spray is used to produce low oxide containing titanium coatings and lower the cost as titanium is a very reactive metal at high temperatures. A solid conical shroud was designed for plasma spray. The titanium coatings were assessed by scanning electron microscopy and energy dispersive X-ray spectroscopy. An analysis in microstructure had been carried out. The results showed that the shroud attachment played an important role in protecting the titanium particles in flight during the process of plasma spraying. An enhanced microstructure with moderate porosity in the titanium coatings plasma sprayed with the shroud was observed. The reduction in air entrainment with the shroud resulted in a good heating of the particles. The plasma-sprayed titanium coating was mainly composed of α-Ti with a low quantity of TiO.
M003 **10:45-11:00**	**Powder Bed Fusion of AlSi10Mg Alloy by High Power Laser: Density, Microstructure and Tensile Properties** ***Liu Mengna,*** Huazhong University of Science and technology, China Abstract: Laser Powder Bed Fusion (LPBF) has been widely accepted as a novel forming method due to its high precision, integrated structure/function for the complex components. The main bottleneck for LPBF is the high cost and long manufacturing term because of its low building rate (typically 5-20cm3/h), which restricts its industrial application fields. In this paper, the high power LPBF (HP-LPBF) technology with a 2kW high-power Gaussian mode laser was used to produce AlSi10Mg alloy samples to enhance the building rates significantly.

	The density, microstructure and tensile properties of the samples by HP-LPBF were studied. The results show that the relative densities of the samples increase firstly and then decrease with the increase of laser energy density. When the laser energy density is 50 J/mm3, the relative density of the HP-LPBF samples reaches its maximum value of 99.75% and the maximum building rate is as high as 144 cm3/h correspondingly, much higher than that with the conventional laser power of 500W. Its microstructure is composed of α-Al matrix and fibrous eutectic Si, which is similar to that of the conventional LPBF (laser power <500W) samples. The grain morphology of the α-Al matrix is a mixture of columnar and equiaxed grains which are nearly random orientated, thus leading to a relatively weak crystallographic texture. The ultimate tensile strength, yield strength and elongation of the high-density HP-LPBF samples are 356.8±20.2 MPa, 254.0±7.7 MPa and 4.8±0.8% respectively, which are higher than those of the die casting AlSi10Mg.
M004 **11:00-11:15**	**Defect, Microstructure and Tensile Properties of In718 Alloy Prepared by Powder Bed Fusion with High Power Laser** ***Jinfeng Deng,*** Huazhong University of Science and Technology, China Abstract: 3D printing metallic components by Laser Powder Bed Fusion (LPBF) has shown a lot of advantages over the traditional forming methods such as casting, forging and welding. However, LPBF has long been constrained within a small industrial range and for the small sizes of components due to its low building rate (typically 5-20cm3/h) and high cost. In recent years, LPBF with high power laser emerged in order to break through the bottleneck of low building rates. In this paper, a 2kW fiber laser with the Gaussian mode was used fabricate 718 alloy components. The molten pool behavior, defect shapes, microstructure and tensile properties of the samples built by different laser powers were studied. The results show that the laser energy densities required for high density components (≥ 99.5%) are approximately the same levels under 1kW and 2kW laser power, with the maximum building rates 36cm3/h and 67.5cm3/h, respectively. The molten pool morphologies of the 1kW sample shows typical "Keyhole type" while that of the 2kW sample shows "Conduction type". The microstructures are composed of columnar grains growing along the building direction at 1kW and 2kW laser power. Large numbers of primary dendrites and Laves brittle phases can be found in the columnar grains. The primary dendrite spacing of the 1kW sample is less than that of the 2kW sample. The 2kW sample has stronger < 001 > texture. The tensile strength of the 1kW sample is obviously higher than 2kW sample due to their difference of microstructures.

M005 **11:15-11:30**	**Fundamental Studies of 316L Components Fabricated by Powder Bed Fusion with High Power Laser** ***Gao Huang,*** Huazhong University of Science and Technology, China Abstract: The lower building rates and high cost have restricted the applications of Laser Powder Bed Fusion (LPBF) in industry. In order to promote the building rates of LPBF, higher power lasers have been used in recent years, which is defined as HP-LPBF. Nevertheless, the influences of high power laser on the densification behavior, microstructure, mechanical properties, and surface quality of the metals remain to be further studied. In this presentation, the HP-LPBF fabrication experiment of 316L stainless steel was carried out by using a 2 kW fiber laser with the Gaussian mode. The influences of laser power (500 W, 1000 W, 2000 W) on the molten pool morphology and the defect characteristics of samples were studied. A printability map was obtained with an optimized relative density higher than 99.8%. The microstructure of the sample mainly consists of coarse columnar grains characterized by epitaxial growth along the deposition direction and a strong <001> texture can be found in the deposited layers. The tensile properties of the HP-LPBF samples exceed the performance requirements of 316L forgings in ASTM A182 standard. The building rates of the HP-LPBF samples increase with the increase of laser power and reach the maximum value of 61.2 cm3/h at 2000W laser power, which is 4 times higher than that at 500W laser power. However, the surface roughness of the HP-LPBF samples also increases with the increase of laser power. Therefore, a reasonable balance between the building rate and the forming precision of the samples should be considered.
M1001 **11:30-11:45**	**Functional Characterization of Shape Memory Alloys** ***Osman Adiguzel,*** Firat University, Department of Physics, Elazig, Turkey Abstract: Shape memory alloys take place in a class of smart materials by giving stimulus response to changes in the external conditions, and exhibiting shape memory effect. These alloys are functional materials with these properties, and used as shape memory elements in many interdisciplinary fields. This phenomenon is result of successive thermally and stress induced martensitic transformations. Shape memory effect is initiated by cooling and deformation processes and performed on heating and cooling after these processes. The material is deformed plastically, it keeps the deformed shape after releasing, strain energy is stored and releases on heating by recovering the original shape. With this property, these alloys are mainly used as deformation absorbent materials in control of civil structures subjected to seismic events,

	due to the absorbance of strain energy during any disaster or earthquake. Thermal induced martensitic transformations occur along with lattice twinning on cooling with cooperative movement of atoms in <110 > -type directions by means of lattice invariant shears on a {110} - type plane of austenite matrix. Twinned structure turn into the detwinned martensite by means of stress induced martensitic by stressing material in the low temperature product phase condition. Copper based alloys exhibit this property in metastable beta-phase region. Lattice invariant shear is not uniform in copper based alloys and cause the formation of unusual complex layered structures. In the present contribution, x-ray diffraction and transmission electron microscopy (TEM) studies were carried out on two copper based CuZnAl and CuAlMn alloys. X-ray diffraction profiles and electron diffraction patterns exhibit super lattice reflections inherited from parent phase due to the displacive character of martensitic transformation. Specimens of these alloys were aged at room temperature for along term, and x-ray diffractograms taken during ageing show that diffraction angles and peak intensities changed. This result refers to a new transition and rearrangement of atoms in diffusive manner.
M1002 **11:45-12:00**	**The effect of defocusing amount on the morphology of melt pool and microstructure in Selective Laser Melting AlSi10Mg** ***Tingting Wang,*** Huazhong University of Science and Technology, China Abstract: Selective Laser Melting (SLM) enables to fabricate complex freeform geometries parts from computer models. In this paper, the effect of defocusing amount on the morphology, surface quality, grain size and texture of the SLMed AlSi10Mg was studied. Deep melt pool was found in 0 mm defocusing amount, while shallow and wide melt pool were found in -1.5 mm and +1.5 mm defocusing amount. Large angle boundaries has a big percentage in 0 mm defocusing amount. Rz has a maximum value of 338 μm in +1.5 mm defocusing amount. The maximum Ra is 33.5 μm in +1.5 mm defocusing amount. When the defocusing amount is 0 mm, the average grain diameter has a minimum grain diameter of 4.9 μm. {001}<100> cubic texture was found in sample fabricated by +1.5 mm defocusing amount rather than 0 mm and -1.5 mm defocusing amount.

M1004 **12:00-12:15**	**Interfacial Reaction-Induced Defect Engineering: Enhanced Visible and Near-Infrared Absorption of Wide Band Gap Metal Oxides with Abundant Oxygen Vacancies** ***Fugong Qi,*** Tianjin University, China Abstract: Modified metal oxides with narrow band gaps have attracted great interest in photothermal applications due to their wide optical absorption range. To tune wide band gap metal oxides into visible and near-infrared responsive materials, we deploy a unique interfacial reaction-induced defect engineering approach, which enables us to effectively modify the electronic structure of metal oxides by introducing oxygen vacancy defects. This approach reduced the band gap of zirconia from 5.47 eV to 1.38 eV, accompanied by a color change to black. More importantly, it is not limited by the size of the metal oxides, and bulk black zirconia was successfully obtained for the first time. It has been demonstrated that the prepared black zirconia can be applied as an effective photothermal therapy agent in vitro. The electrical and thermal properties of black zirconia were also evaluated by simulated or experimental methods. Additionally, the interfacial reaction-induced defect engineering approach has been successfully extended to enhance the optical absorption of other metal oxides.
M006 **12:15-12:30**	**Interfacial phenomena and microstructure of copper/steel bimetal structure produced by a new hybrid additive manufacturing process combining selective laser melting and directed energy deposition** ***Wenqi Zhang,*** Huazhong University of Science and Technology, China Abstract: As a novel exploration, hybrid additive manufacturing (AM) process combining selective laser melting (SLM) and directed energy deposition (DED) was used to produce a copper/steel bimetal structure in this paper. Stainless steel was deposited on SLM-ed CuCr substrate successfully produced by DED on the SLMed Cu-Cr alloy substrate. The interfacial phenomena, microstructure, and forming mechanism were investigated systematically. The Cu element of the substrate flowed up due to the Marangoni flow, and liquid phase separation occurred during the process. This work indicates that the microstructure and morphology between the cladding layer of steel and Cu-Cr substrate is significantly influenced by the laser power.

Poster Session 15:40-16:00, Nov. 5, Friday | Room ID: 167 248 058	
M007	**Synthesis and photocatalytic application of Mn3O4/CdS composite** ***Wu Chaohua,*** Wuhan University of Technology, China
M1003	**Experimental study on sliding bearing of sink roll in galvanizing line** ***Wenxun Jiang,*** Shanghai University, China
M001	**Synthesis and photocatalytic application of Mn_3O_4/CdS composite** **Zheyuan Liu,** Jiangxi Science and Technology Normal University,China
M1009	**Study on interface evolution behavior during high temperature brazing of aluminum/steel composites** **Xiaojun Zhang,** Beijing University of Technology, China

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