Welcome Messages

Dear colleagues,

It is our great pleasure and privilege to welcome you to the virtual edition of MEACM2022, the 2022 5th International Conference on Mechanical Engineering and Applied Composite Materials. The conference will be held from December 29, 2022 and is now accessible to registered participants worldwide.

On this great gathering, Organizing Committee invites participants from all over the globe to take part in this annual conference with the theme “Mechanical Engineering and Applied Composite Materials”. MEACM2022 aims at sharing new ideas and new technologies amongst the professionals, industrialists and students from research areas of Advanced Materials and Nanotechnology to share their recent innovations and applications and indulge in interactive discussions and technical sessions at the event..

Submitted papers will be peer reviewed by conference committees, the accepted papers that presented at the conference will be included into MEACM2022 conference proceedings, and be published with "Key Engineering Materials" or "Materials Science Forum".

We would like to thank and welcome everyone, and hope you will enjoy MEACM2022.

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Content

Note:

- All the participants are strongly advised to attend 10 minutes before the Webinar is start.
- Zoom ID and instructions will also be sent 5 days before the conference.
- The standard time for all programs is Beijing Time

Instructions about Oral Presentation

- Materials Provided by the Presenters: PowerPoint or PDF files
- Duration of each Presentation: Regular Oral Session: About 8 Minutes of Presentation and 2 Minutes of Q&A.

Committee

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Prof. Katsuyuki Kida, University of Toyama, Japan

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Time Schedule (Beijing Time, UTC/GMT+8)

December 29, 2022 UTC/GMT+8 (Online in ZOOM)		
Speaker's time slot	**Standard Time (GMT+8)**	**Presentation Information**
	8:55-9:00 am	**Opening Speech**
	9:00-11:40 am	**Keynote & Invited Session**
19:00-19:30 pm UTC/GMT-6	**9:00-9:30 am**	**Numerical Study of the Internal Flow Characteristics in a Free-Piston Stirling Engine** Prof. Songgang Qiu | West Virginia University, USA
9:30-10:00 am UTC/GMT+8	**9:30-10:00 am**	**The Approximate Solutions of Vibrations of Large Deformation of a Cantilever Beam with the Extended Galerkin Method** Prof. Ji Wang | Ningbo University, China
11:00-11:30 am UTC/GMT+9	**10:00-10:30 am**	**Fracture mechanics and rolling contact fatigue of silicon nitride ball bearings.** Prof. Katsuyuki Kida | University of Toyama, Japan
	10:30-10:40 am	**Break & Phtoto**
10:40-11:10 am UTC/GMT+8	**10:40-11:10 am**	**Damping enhancement of nanocomposites via carbon nanotubes and graphene** Assoc. Prof. Zhaoye Qin I Tsinghua University, China
12:10-12:40 pm UTC/GMT+9	**11:10-11:40 am**	**3D printed composites: review in Tokyo Institute of Technology** Prof. Akira Todoroki l Tokyo Institute of Technology, Japan
	11:40-13:00 pm	**Break**
	13:00-14:30 pm	**Keynote & Invited Session**
14:00-14:30 pm UTC/GMT+9	**13:00-13:30 pm**	**Tribological effect of rotation of radial polymer (PEEK, PPS and PTFE) bearings on wear tracks based on chemical and mechanical observations** Assoc. Prof. Koshiro Mizobe l University of Toyama, Japan
8:30-9:00 am UTC/GMT+3	**13:30-14:00 pm**	**Shape Reversibility and Thermomechanical Behavior of Shape Memory Alloys** Prof. Dr. Osman Adiguzel l Firat University, Elazig, Turkey
7:00-7:30 am UTC/GMT+1	**14:00-14:30 pm**	**Recent review of parameter identification for optimal design of materials & structures** Prof. Dr. David BASSIR l ENS Cachan / Université Paris-Saclay, Centre Borelli, France
15:30-16:00 pm UTC/GMT+9	**14:30-15:00 pm**	**Some Topics of Nondestructive Techniques (NDT): Acoustic Emission (AE) for Ceramics and Infrared Thermography (IRT) for Flexible Solar Cell** Dr. Takahiro Matsueda | University of Toyama, Japan
	15:00-15:10 pm	**Break**
Speaker's time slot	**Standard Time (GMT+8)**	**Presentation Information**
	15:10-18:00 pm	**Oral Session**
15:10-15:20 pm UTC/GMT+8	**15:10-15:20 pm**	**3: Significant enhancement of tribological properties of microcapsule composites under high loads by incorporating PTFE** YiLong Ren | Tsinghua University, China
15:20-15:30 pm UTC/GMT+8	**15:20-15:30 pm**	**ME508: On crashworthiness and energy-absorbing mechanisms of thick CFRP structures for railway vehicles** Dongdong Chen | Southwest Jiaotong University, China
15:30-15:40 pm UTC/GMT+8	**15:30-15:40 pm**	**ME515: Effect of Al Content on Microstructure and Properties of Cu-14Ni-xAl Alloys** Dongmei Liu | GRIMAT Engineering Institute Co., Ltd.
16:40-16:50 pm UTC/GMT+9	**15:40-15:50 pm**	**ME520: Observation of Mode I Crack Growth Behavior in 4.762 mm Diameter-Silicon Nitride Ball under Compressive-Tensile Cyclic Loadings** Ryota Hayashi | University of Toyama, Japan
16:50-17:00 pm UTC/GMT+9	**15:50-16:00 pm**	**ME521: Effect of load on surface roughness of PPS thrust bearings under rolling contact fatigue in water** Shuhei Kajiwara | University of Toyama, Japan

December 29, 2022 UTC/GMT+8 (Online in ZOOM)		
Speaker's time slot	**Standard Time (GMT+8)**	**Presentation Information**
	9:00-11:40 am	**Keynote & Invited Session**
17:00-17:10 pm UTC/GMT+9	**16:00-16:10 pm**	**ME522: Friction coefficient during five-phased start-stop tests of PEEK-PTFE hybrid radial ball bearings reaching 50 C° under 487N at 600rpm in air** Shota ADACHI | University of Toyama, Japan
17:10-17:20 pm UTC/GMT+9	**16:10-16:20 pm**	**ME523: Influence of Groove Roughness on Crack Initiation of PEEK Thrust Bearing in Water** Takahiro Matsueda | University of Toyama, Japan
16:20-16:30 pm UTC/GMT+8	**16:20-16:30 pm**	**ME524: Homogeneous interfacial water structure favors realizing a low-friction coefficient state** PingSu Ma | Tsinghua University, China
17:30-17:40 pm UTC/GMT+9	**16:30-16:40 pm**	**ME525: Forming Parameters and Optimization of A5052 in SPIF Process** Dong Won Jung | Jeju National University, Korea
17:40-17:50 pm UTC/GMT+9	**16:40-16:50 pm**	**ME526: Deformation Evaluation of A5052 sheet metal in SPIF Process.** Dong Won Jung | Jeju National University, Korea
16:50-17:00 pm UTC/GMT+8	**16:50-17:00 pm**	**ME527: Effect of strength ratio and loading sequence on the adiabatic shearing behavior of Ti-TC4 layered composites** Yumeng Luo | GRIMAT Engineering Institute Co., Ltd.
18:00-18:10 pm UTC/GMT+9	**17:00-17:10 pm**	**MS802: Microstructure observation around hardness transition area of repeated induction heated S45C shaft** Yuki Nakasone | University of Toyama, Japan
18:10-18:20 pm UTC/GMT+9	**17:10-17:20 pm**	**MS803:Observation of Microstructures in Carburized-Quenched SCM415 Steel under Rotating Bending Fatigue of 716 Mpa** Shusuke KITA | University of Toyama, Japan
18:20-18:30 pm UTC/GMT+9	**17:20-17:30 pm**	**MS805: Observation of Internal Fatigue Cracks in Repeatedly Induction-Heated S45C Steel under Rotating Bending Fatigue** Shusuke KITA | University of Toyama, Japan
18:30-18:40 pm UTC/GMT+9	**17:30-17:40 pm**	**MS804: Effects of Loading Magnitude and Fatigue Crack Growth on Crack Opening-Closing Behavior on Silicon Nitride Ball under Cyclic Compression** Soji Matsubayashi | University of Toyama, Japan
18:40-18:50 pm UTC/GMT+9	**17:40-17:50 pm**	**MS806: Observation of transition area origin cracks on fracture surfaces of carburized JIS SCM415 bars** Yuki NAKASONE | University of Toyama, Japan
16:50-17:00 pm UTC/GMT+7	**17:50-18:00 pm**	**5: Dynamic Modeling and Analysis of Rotor-Bearing System with Localized Defect in Rotating Machinery** Pirapat Arunyanart | King Mongkut's University of Technology North Bangkok, Thailand

Keynote Speakers

Prof. Songgang Qiu
West Virginia University, USA
Speech Title: Numerical Study of the Internal Flow Characteristics in a Free-Piston Stirling Engine

Prof. Qiu has extensive experiences in the analysis and design of power generator, gas and liquid fuel burners, and heat exchangers. He is currently working on the development of a SOLID FUEL BURNER. This burner is to be used to gasify supplied charcoal, combusts and transfers heat to a Stirling engine for power generation. He is also developing an advanced Stirling generator for combined heating and power generation under a DOE ARPA-E grant.
Prof. Qiu has served as PI for numerous research projects funded by DOE, DoD (Army, Navy, Air Force) and NASA. He was the prime designer of an Advanced Radioisotope Stirling Generator (ARSG) for NASA/DOE. He is the lead inventor of 9 issued US patents.

Prof. Ji Wang
Ningbo University, China
Speech Title:The Approximate Solutions of Vibrations of Large Deformation of a Cantilever Beam with the Extended Galerkin Method

Prof. Ji Wang has been a Qianjiang Chair Professor of Zhejiang Province at Ningbo University since 2002. He also served as Associate Dean for Research and Graduate, School of Mechanical Engineering and Mechanics, Ningbo University, from 2013 to 2019. Professor Ji Wang is the founding director of the Piezoelectric Device Laboratory, which is a designated Key Laboratory of City of Ningbo. Professor Ji Wang was employed at SaRonix, Menlo Park, CA, as a senior engineer from 2001 to 2002; NetFront Communications, Sunnyvale, CA, as senior engineer and manager from 1999 to 2001; Epson Palo Alto Laboratory, Palo Alto, CA, as Senior Member of Technical Staff from 1995 to 1999. Professor Ji Wang also held visiting positions at Chiba University, University of Nebraska-Lincoln, and Argonne National Laboratory. He received his PhD and Master degrees from Princeton University in 1996 and 1993 and bachelor from Gansu University of Technology in 1983. Professor Wang has been working on acoustic waves and high frequency vibrations of elastic and piezoelectric solids for resonator design and analysis with several US and Chinese patents, about 200 journal papers, and frequent invited, keynote, and plenary presentations in major conferences around world. He has been board members, advisors, and consultants to many leading companies in acoustic wave device industry. Professor Wang has been a member of many international conference committees and currently serving the IEEE UFFC Technical Program Committees of the Frequency Control and Ultrasonics Symposia, the IEEE MTT-S, and the IEC TC-49. He is also the funding chair of Committee on Mechanics of Electronic and Magnetic Devices, CSTAM, and the SPAWDA. From 2015, Profess Wang is the editor-in-chief of Structural Longevity and members of the editorial boards of several international journals.

Prof. Katsuyuki Kida
University of Toyama, Japan
Speech Title: Fracture mechanics and rolling contact fatigue of silicon nitride ball bearings

Prof. Katsuyuki Kida was born in 1968 in Osaka, where he studied mechanical engineering at Osaka University from 1988. Apart from course work, he studied rolling contact fatigue (RCF) occurring in TiC and TiN coated steels using both X-ray diffraction and scanning acoustic microscopy. After graduation he pursued his academic career and obtained a Ph.D. in engineering mechanics in 2000, investigating RCF problems of all-Si3N4 bearings. By observing cracking and flaking failure under RCF, he succeeded in explaining the material`s features from the viewpoint of fracture mechanics. From 2000 he focused his work on investigating the contact problems of several materials used in machine elements. He has also continued fundamental research on contact problems, for which he received 'The Best Paper Prize (FFEMS PRIZE)' from 'Fatigue & Fracture of Engineering Materials & Structures' journal in 2005. The awarded papers reported establishing a crack growth mechanism under contact pressure, a problem previously unsolved for over 70 years since S. Way's proposed theory. His research interests now include the development of three dimensional scanning Hall-probe microscope technologies, fatigue phenomena in polymer bearing, crack growth mechanism under contact stresses and refinement of high-carbon steels. He holds and has held a number of prestigious leadership roles in academy-industry corroboration programs: refinement of steels, new joint system in humanoid robots and fatigue of polymer bearings in "Strategic Fundamental Technologies Strengthening Assistance Programs" (Ministry of Economics, Trade and Industry, Japan, 2009-2013); scanning Hall-probe microscopy in "Fundamental Studies on Technologies for Steel Materials with Enhanced Strength and Functions" (Consortium of the JRCM, Japan, 2008-2012); and ceramic bearing elements in the project supported by "Japanese Energy and Industrial Technology Development Organization" (NEDO, Japan, 2007-2011)." As a chairperson of department of mechanical engineering in University of Toyama, Professor Kida is heading education and research projects (2019-)..

Assoc. Prof. Zhaoye Qin
Tsinghua University, China
Speech Title: Damping enhancement of nanocomposites via carbon nanotubes and graphene

Dr. Qin is currently an associate professor at Department of Mechanical Engineering in Tsinghua University, China. He received the B.S. and M.S. degrees in Mechanical Engineering from Northeastern University, China, in 2003 and 2006, respectively, and the Ph.D. degree in Mechanical Engineering from Tsinghua University, China, in 2010. He is serving as an Associate Editor of Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, and an Editorial Board Member of Nanotechnology Reviews. His research interests include structural dynamics, rotordynamics and condition monitoring, nanocomposites, vibration control, and energy harvesting. Dr. Qin has published more than 100 SCI-index journal papers. He received the Youth Science and Technology Award from Chinese Society of Vibration Engineering in 2020.

Prof. Akira Todoroki
Tokyo Institute of Technology, Japan
Speech title: 3D printed composites: review in Tokyo Institute of Technology

Prof. Akira Todoroki has been a faculty (assistant, associate, full professor) at the Department of Mechanical Engineering, School of Engineering, Tokyo Institute of Technology, Japan, since 1988. He also served as a visiting researcher in the University of Florida, USA (1995-1996). His research interests include 3D printed composites, self-sensing composites, and optimizations of composite structures. He won prestigious awards from JSME, JSCM, JSMS, JRPS, SAMPE Japan and JSASS.

Prof. Koshiro Mizobe
University of Toyama, Japan
Speech title: Tribological effect of rotation of radial polymer (PEEK, PPS and PTFE) bearings on wear tracks based on chemical and mechanical observations

Koshiro Mizobe is a professor in the Department of Mechanical Engineering at the University of Toyama, Japan. He has published over 50 papers in various research fields including: evaluation of stress intensity factors, repeated heating, homology evaluation of microstructure, and polymer bearings. Koshiro studied mechanical engineering at Kyushu University, Japan, graduating in 2013. He studied the repeated quenching refinement method of high-carbon chromium steels in his PhD course. For this work he received the Research Fellowship for Young Scientists in 2013-2014 from the Japan Society for the Promotion of Science as well as Top Young Researcher Award in 2012 from Kyushu University. Since 2015 he has been an assistant professor in the Department of Mechanical Engineering at the University of Toyama. He has won some best paper awards from international committees (ICMDME, CMPSE and ICMTM) and received some grants (25th ISIJ research promotion grant from the Iron and Steel Institute of Japan and research promotion grant from JKA). His current research topics with a brief explanation are as follows. Repeated heating method Martensitic high-carbon high-strength bearing steel is one of the main alloys used for rolling contact applications where high wear resistance is required. Refining the prior austenite grain size through repeated heating is a process commonly used to enhance the material's strength. He studied the effect of repeated heating on the microstructure near inclusions through the rolling bending fatigue tests. Development of hybrid polymer bearings Koshiro is focusing on polymer bearings because it is suitable for the no lubricant situation and the corrosive situations. In particular, he focuses on PEEK which is a tough semi-crystalline thermoplastic polymer and PTFE which has low friction coefficient. Now, he develops the combination of PEEK races-PTFE retainer bearings.

Prof. Dr. Osman Adiguzel
Firat University, Elazig, Turkey
Speech tItle: Shape Reversibility and Thermomechanical Behavior of Shape Memory Alloys

Dr. Osman Adiguzel graduated from Department of Physics, Ankara University, Turkey in 1974 and received PhD- degree from Dicle University, Diyarbakir-Turkey. Dr. Adiguzel served his directorate of Graduate School of Natural and Applied Sciences, Firat University in 1999-2004. He supervised 5 PhD- theses and 3 M. Sc theses. He is also Technical committee member of many conferences. He received a certificate which is being awarded to him and his experimental group in recognition of significant contribution of 2 patterns to the Powder Diffraction File – Release 2000. The ICDD (International Centre for Diffraction Data) also appreciates cooperation of his group and interest in Powder Diffraction File. He published over 60 papers in international and national journals; He joined over 120 conferences and symposia in international and national level as Plenary Speaker, Keynote Speaker, Invited speaker, speaker or Poster presenter. He served the program chair or conference chair/co-chair in some of these activities. In particular, he joined in last even years (2014 - 2020) over 80 conferences as Speaker, Keynote Speaker and Conference Co-Chair organized by different companies in different countries. Additionally, he retired at the end of November 2019, and contributed with Keynote/Plenary. Scientific fields: Shape memory effect and displacive phase transformations in shape memory alloys and other alloys, molecular dynamics simulations, alloy modeling, electron microscopy, electron diffraction, x-ray diffraction and crystallography.

Prof. Dr. David BASSIR
ENS Cachan / Université Paris-Saclay, Centre Borelli, France
Speech tItle: Recent review of parameter identification for optimal design of materials & structures

David Bassir is Professor at the French University of Technology and Senior Researcher at ENS Cachan/ Université Paris-Saclay. He holds MSc and PhD in structural optimization from University of Franche-Comte and Doctor Honoris Causa from, Yuzuncu Yil University, Turkey. His administrative positions and duties included Dean at University Institutes of Technology, University of Lorraine, Consul of Science and Technology at the French Embassy in China, General Director of Research at the ESTP-ENSAM (Paris), Space Craft engineer at GECI Technology in different Space Agencies such as Arianespace (France) and Matra Marconi Space (Astrium Group) and more. Prof. Bassir was an invited visiting professor in leading universities, including TUDelft, Shanghai Jiaotong, Northwestern Polytechnical (Xian), University of Oviedo, MIT Boston and Chinese Academy of Sciences. He published over 120 papers in journals, books and conference proceedings on various subjects of Composites materials, Parameter identification, Additive manufacturing, Structural Optimization and Multiscale modelling and analysis. He serves as member of various expert committees in many international organizations and highly estimated scientific societies. Since 2012, he is the founder and the president of the Sino-french Association for Sciences and Technology.
Prof. Bassir is also editor-in-chief of ijsmdo journal, Guest editor for Mathematics, composites and advanced materials and member of the editorial board of Mathematical Problems in Engineering and Journal of the Mechanical Behavior of Materials

Dr. Takahiro Matsueda
University of Toyama, Japan
Speech title: Some Topics of Nondestructive Techniques (NDT): Acoustic Emission (AE) for Ceramics and Infrared Thermography (IRT) for Flexible Solar Cell

Takahiro Matsueda is an assistant professor in the Department of Mechanical Engineering at the University of Toyama, Japan. He has investigated evaluation of fatigue strength of steel, stress intensity factors of microcrack, nondestructive testing and evaluation of material strength such as solar cell, ceramics and polymer. Takahiro Matsueda graduated from mechanical engineering at Kyushu University, Japan, in 2014. He majored in evaluation method of fatigue strength with notched steel in a PhD course. He was an assistant professor in the Department of Mechanical Engineering at the Tokyo Metropolitan University from 2015 to 2019. He has been an assistant professor in the Department of Mechanical Engineering at the University of Toyama from 2020. He has also won awards for research from international committees (ICSMMS, ICMEMSCE and ICMTM). Brief introductions of current research topics are as follows. Nondestructive evaluation of materials using AE and LT techniques Takahiro Matsueda's research aims to reveal the mechanisms of microcrack initiation and accumulation, and their contribution to the electrical degradation during fatigue fracture. He detected and identified microcrack initiation using the acoustic emission (AE) and Lock-in thermography (LT) techniques. The electrical degradation of solar cell was evaluated by monitoring electrical power calculated from Current-Voltage (I-V) curve. Furthermore, microdamage contributing to the electrical degradation were identified by Lock-in thermography (LT). He proposed the method to evaluate microcrack initiation using the AE, LT and I-V curve. Prediction method of fatigue limit in metal materials Takahiro Matsueda is studying the new prediction method based on fracture mechanics for safely design. In particular, he focuses on improvement of the method to define the fatigue crack shape and propagating during fatigue test.

Oral Session

Paper ID: 3

Title: Significant enhancement of tribological properties of microcapsule composites under high loads by incorporating PTFE

Abstract: Although microcapsules can remarkably diminish the friction coefficient and wear rate of the composites, most of the superior tribological properties are achieved under small contact areas and low loads. To enhance the tribological performance of microcapsule-containing composites at large contact areas and high loads, the PTFE is introduced to construct PTFE/microcapsule/epoxy composites. The resulted composites maintain a low coefficient of friction (COF) of 0.057 and a wear rate of 1.45 10-7 mm3/Nm against PH13-8Mo Steel in ring-on-ring test configuration at 1500 N (12.7 MPa), where the microcapsule/epoxy composite fails to ensure constant and adequate lubrication. The effect of the PTFE content on the mechanical and tribological properties has been methodically examined and discussed in some detail. The analysis results provide evidence that the island-like transfer film associated with the PTFE is essential for the intense enhancement of tribological properties. The transfer film tends to lessen the solid friction resulting from the direct contact of asperities in mixing or boundary lubrication while the reducing lubricant film failure is essentially caused by high flash temperature. Additionally, the oleophobic properties of the PTFE promote oil lubrication under a limited oil supply. This work aims to extend service conditions and promote applications of microcapsule/epoxy composites in mechanical components.

Paper ID: ME508

Title: On crashworthiness and energy-absorbing mechanisms of thick CFRP structures for railway vehicles

Abstract: This study aims to provide important guidelines for the crashworthiness design of composite energy-absorbing structures, especially railway vehicles. An experimental and numerical investigation was carried out to explore the crushing response of circular composite tubes reinforced with plain woven carbon fiber reinforced polymers (CFRP). Quasi-static and dynamic axial crushing tests were performed on CFRP tubes with an inner diameter of 100 mm and a nominal wall thickness of 12 mm. Experimental results showed that increasing loading velocity led to a 21.8% reduction of specific energy absorption (from 99.7 kJ/kg to 78.7 kJ/kg) but had negligible influence on failure modes. Finite element models were also established and validated against the experimental results using ABAQUS/Explicit software. The effects of several different parameters such as the number of shell layers, friction coefficient, and interface properties on the simulated results, were also investigated and analyzed. The comparisons between the predicted and experimental results indicated that a finite element model with 10 shell layers could effectively replicate the crushing response. In addition, the simulated results indicated that the damage of tubal wall materials dominated the major energy-absorbing mechanisms of CFRP tubes under quasi-static loads, which was 69.1% of the total energy. The energy dissipated by friction effects between the loading platen and the crushed fronds was 24.1% of the total energy. The increase in the loading velocity led to a decrease in the composite damage energy except friction energy, resulting in a decrease in the total energy absorption.

Paper ID: ME515

Title: Effect of Al Content on Microstructure and Properties of Cu-14Ni-xAl Alloys

Abstract: This paper focuses on the influence of Al content on the microstructure and properties of Cu-14Ni-xAl alloys, with the mass fraction of aluminum element ranging from 0 to 5% as the object. First, the evolution of Vickers hardness and electrical conductivity of Cu-14Ni-xAl alloys during aging were tested. Then a comparative study of the friction and wear behavior of Cu-14Ni-xAl alloys with different Al contents were studied. The results show that the alloy with Al content of 3% possesses the best mechanical and friction performance, with the hardness of HV 275.0 and friction coefficient of 0.7 in the peak-aged state. Microstructure analysis show that the precipitates are denser and the volume fraction of aging induced precipitates are more in the Cu-14Ni-3Al alloy, compared with that in the other studied alloys. Finally, the correlations between the Al content, microstructure, the mechanical and tribological properties of the Cu-Ni-Al alloys were further discussed.

Paper ID: ME524

Title: Homogeneous interfacial water structure favors realizing a low-friction coefficient state

Abstract: The use of water to reduce friction has always played a significant role in a wide range of areas ranging from biology to engineering. Many efforts have been made to extensively investigate the water behavior between two contacted surfaces, but its role in water-based friction remains incompletely understood. Herein, we identify different interfacial water structures upon adjusting the wettability of titanium dioxide (TiO2) and silicon surfaces using sum-frequency generation (SFG) spectroscopy and observe opposite wettability-tunable underwater friction by atomic force microscopy (AFM), demonstrating that enhanced wettability induces higher friction on the TiO2 surface but lower friction on the silicon surface. Although the tribological properties of TiO2 show independence of surface forces in contrast to the case of silicon, both TiO2 and silicon surfaces covered with homogeneous water molecules correspond to a lower friction coefficient. This observation indicates that a homogeneous interfacial water structure, dominating over surface forces, is of the utmost importance for achieving low friction. Our results shed new light on the origins of friction in the presence of water and reveal the ubiquitous role of interfacial water structures on friction.

Paper ID: ME525

Title: Forming Parameters and Optimization of A5052 in SPIF Process

Abstract: Forming a metallic sheet along with the consideration of computer simulation and experiment had benefited the milling industry for a long time. The ideal forming, without an error, is a concerning topic. So, the computer simulation had the advantage then direct forming. To observe the results before doing the real experiments simulation comes handy. Which helped to set the parameters for the milling process for the single point incremental forming (SPIF) process. For milling, a CAD design was converted into a 3D model. For this, a conical shape of 3D modeling was made in fusion 360. After onwards, it was simulated for finding the maximum depth for the cracking point. Next for the experimental part, the maximum forming depth was considered, and used lubricant grease for reducing friction. While forming with the grease, the impact of parameters was also changed. Throughout the process, an optimization approach was set to reduce the cracking areas for the G-code. Along with the lubricant use, smooth milling finished surface was observed. To reducing the depth forming errors, an optimization approach was introduced in this research.

Paper ID: ME526

Title: Deformation Evaluation of A5052 sheet metal in SPIF Process

Abstract: The single point incremental forming (SPIF) process is a high-trend method for forming a metal in a desirable shape. Forming parameters is an important part of deforming metal sheets. So, while reshaping a metal sheet parameters like tools, toolpath, material properties, sheet thickness, and lubricant were considered. Since the Aluminum sheet is used world widely for the body parts of machines for manufacturing parts. So, an A5052 metallic sheet was formed for the improvement of the depth deforming through the SPIF process. While forming an A5052 sheet lubricant was used constantly. After deforming through the SPIF process, further evaluations of the formed part were examined with the nano profiling machine to evaluate the deformed areas. Moreover, the deformed part was analyzed for the nana profiling for the deformation occurs on the surface. Likewise, before forming a part, the A5052 design was computer analysis. The simulation part was studied for fixing the maximum depth.

Paper ID: ME527

Title: Effect of strength ratio and loading sequence on the adiabatic shearing behavior of Ti-TC4 layered composites

Abstract: Ti-TC4 layered composites were prepared by laser additive manufacturing, and the strength ratio of the two matrixes were adjusted by heat treatment. The adiabatic shearing behavior of the composite was studied by using SHPB at a strain rate of 3000 s-1. The results show that the strength ratio of two matrixes and loading sequence will affect the failure mode and the amount of energy absorption: when the strength ratio of pure Ti and TC4 is about 40%, the TC4-Ti loading order specimen shows a 10% increase of absorption energy compared with the Ti-TC4 loading order specimen. The adiabatic shearing band (ASB) is generated at TC4 near the bottom of the sample and greatly deflected by the Ti-TC4 interface, while the ASB is generated from the TC4 matrix closing to the Ti-TC4 interface in the Ti-TC4 loading order specimen. When the strength ratio of pure Ti and TC4 is about 67%, ASB is generated from the bottom of the specimen in TC4 matrix despite the loading sequence. At this time, the bearing capacity of both is equivalent, but the energy absorption is reduced by about 20%~30% compared with that under a strength ratio of 40%.

Paper ID: ME520

Title: Observation of Mode I Crack Growth Behavior in 4.762 mm Diameter-Silicon Nitride Ball under Compressive-Tensile Cyclic Loadings

Abstract. Cyclic pressure fatigue tests of silicon nitride ball were performed in two phases. In the first phase, compressive and tensile stresses were applied to two cracks on the ball surface, respectively. In the second phase, tensile stress was applied to the crack that was applied to compressive stress in the first phase to grow. The effect of cyclic compressive stress on crack growth was investigated through this series of tests. The results are as follows. The ball did not fracture in either Phase 1 or Phase 2 tests. The crack did not propagate when the maximum compressive load of approximately 5 kN was repeatedly applied across the crack surface. In addition, the crack applied with compressive stress before tensile stress, and the crack which was not, both grew to about 520 μm during N ranging from 0 to 1.2×107 fatigue cycles. The crack applied with compressive stress before tensile stress at fatigue cycles N = 103 grew about 170 μm longer than the crack to which stress was not applied.

Paper ID: ME521

Title: Effect of load on surface roughness of PPS thrust bearings under rolling contact fatigue in water

Abstract. Rolling bearings are important mechanical parts. They are used for the transmission of rotational motion. In this study, we focused on surface roughness of the polymer thrust bearing under rolling contact fatigue. Surface roughness of the groove bottom was measured when small pitting around shoulder and crack occurred. Thrust bearings were loaded with thrust loads of 2300 N, 2400 N, 2500 N, and 2600 N. The surface in the rolling contact area was worn during the rolling contact fatigue test. We concluded that surface roughness values ranged from 0.49 μm to 0.18 μm, under thrust loads of 2300 N, 2400 N, 2500 N, and 2600 N when small pitting occurred.

Paper ID: ME522

Title: Retained Austenite Reduction near Fracture Surface in Repeatedly Quenched SUJ2 Steel

Abstract:

High-carbon high-strength JIS-SUJ2 bearing steel is an alloy having the characteristics of high wear resistance and fatigue strength as a result of quenching. When this kind of high-strength material is exposed to long-lasting low stress application loadings, fisheye fractures can often be seen. In this research, we measured the retained austenite near the fracture surface in JIS-SUJ2. After the measurement, we confirmed the decrease of the retained austenite in the vertical surface under both fisheye fracture and ductile fracture.

Paper ID: ME523

Title: Influence of Groove Roughness on Crack Initiation of PEEK Thrust Bearing in Water

Abstract. In order to research the relation between fracture and texture conditions of PEEK thrust bearing in water, the rolling contact fatigue, RCF test was carried out. And then, the specimen after test was observed with a laser confocal microscope. Three types of surface damage: single crack, flaking and multiple crack: were observed. Arithmetic Average Roughness Height, AARH's around single crack and no-damaged area were calculated. AARH's in these two areas have no significantly different each other. This means the effect of cracks on roughness was negligible, and vice versa. The changing of AARH during the test was also dis-cussed. AARH's both of failure and non-failure specimens were decreased during RCF tests. AARH Range of non-failure specimens after test included that of the failure specimen. It indicated AARH was not dominated the condition failure of PEEK bearing in water. On the other hands, the load had a clear threshold. This means the failure of PEEK bearing in water is strongly affected by load.

Paper ID: MS802

Title: Microstructure observation around hardness transition area of repeated induction heated S45C shaft

Abstract. It had been reported that repeated induction heating process decreased the prior austenite grain size and refined the martensitic structure of JIS SUJ2 samples. In the present work, we compared hardness values and structures of hard surface and soft core of three-times repeated induction heated and once tempered (IH Q3T1) JIS S45C steel bar specimen and once induction heated and once tempered (IH Q1T1) bar. Structures consist of three areas: Hard; Transition; and Soft Core Areas. Martensite, ferrite and martensite, and ferrite and pearlite were observed at the Hard, Transition, and Soft Core Areas. From these observations, it was found that ferrite ratio increased with depth from the surface, and repeated induction heating had little effect on the hardness distribution and internal structure.

Paper ID:MS803

Title: Observation of Microstructures in Carburized-Quenched SCM415 Steel under Rotating Bending Fatigue of 716 MPa

Abstract. Carburized-quenched steel has a hard layer on the surface and a soft layer in the core. Internal fatigue cracks are observed around the boundary between these two layers under cyclic stress. In this research, we investigated the microstructures (carbon content, prior austenite grains and retained austenite) in the carburized-quenched chromium molybdenum steel bar (JIS-SCM415, diameter = 10 mm) failed by rotating bending test (RBT) at nominal stress amplitude of 716 MPa. After the investigations, we obtained three conclusions: the carbon content in the area from the surface to 0.1 mm depth was higher than other area; the prior austenite grain (PAG) sizes at 0.1 mm depth from the surface was almost the same as that of 0.6 mm depth; and the retained austenite which was indicated from the ratio of γ to α in the cross section ranging from the surface to 0.1 mm depth was decreased by rotating bending fatigue.

Paper ID: MS804

Title: Effects of Loading Magnitude and Fatigue Crack Growth on Crack Opening-Closing Behavior on Silicon Nitride Ball under Cyclic Compression

Abstract. To research effects of cyclic loadings and the loading magnitude on the crack opening-closing behavior, crack opening displacement evaluations for fatigue cracks on a silicon nitride ball were carried out. The compressive loading magnitude, which was less than 2.7 kN, did not affect crack opening-closing behavior. The crack opened at the early cycles of fatigue during 0 to 〖10〗^3 cycles.

Paper ID: MS805

Title: Observation of Internal Fatigue Cracks in Repeatedly Induction-Heated S45C Steel under Rotating Bending Fatigue

Abstract. Induction-heated steel has hard and soft layers. These layers can cause an internal fatigue crack originating from the boundary of these layers when cyclic stress is applied. Repeated heating is known as a method for improving fatigue strength, and it was applied to induction heating method. Repeatedly induction-heated steel had high fatigue strength compared to single quenching. We performed rotating bending fatigue tests of low carbon steel (JIS-S45C) induction-heated three times, and observed the fracture surfaces and the microstructures of internal fatigue cracks. The internal fatigue cracks originated from the area around the boundary between soft and hard layers surrounding crack origin. Some pearlite and ferrite can be seen. There were pearlite and dimples on the soft layer of internal fatigue crack and clear grains on the hard layer of the crack. From chase-up observation, we revealed that internal fatigue crack originated from soft layer.

Paper ID: MS806

Title: Observation of transition area origin cracks on fracture surfaces of carburized JIS SCM415 bars

Abstract. Under high cycle and very high cycle fatigue, high strength steels break as a result of internal fracture from inclusions. In order to understand this fracture, “Fisheye” crack has been investigated. In our previous work we found that cracks grew from the boundary between the hard surface and soft core of case-hardened S45C, SUJ2 and SCM415 steel bars under rotating bending fatigue. These cracks were called “Transition area origin (TRO)” cracks. In this study, we closely observed the fracture surface of TRO crack areas in carburized JIS SCM415 specimens (under 734, 776 and 865 MPa). We found three features of the TRO cracks: outside of the TRO cracks had asperities; the shapes of TRO cracks were almost circular, and were different from those in S45C and SUJ2 steels; and the HAZ-TRO area which was located at hardened layer had some ridges, and the Core-TRO area at unheat-treated layer was smooth and flat.

Paper ID: 5

Title: Dynamic Modeling and Analysis of Rotor-Bearing System with Localized Defect in Rotating Machinery

Abstract. The numerical model is developed to study the vibration response due to the localized defect of ball bearing in rotating machinery. In order to simulate the dynamic response, the equations of motions are developed based on the rotor-bearing system where two identical rotors mounted on symmetric flexible shaft and supported by ball bearings are considered in this model. The presence of defect is introduced on a bearing outer raceway and lubrication effect between bearing components is also included. The numerical results are obtained by applying Runge–Kutta method to solve governing equations of motions. It has been observed that the vibration spectrum of the ball pass frequency outer race and its harmonics for the defect bearing is relatively higher than the good one. Moreover, this dynamic model can effectively enhance the understanding of vibration responses for good and defective bearing.