TINT IS ORGANISING

POLYTRIB 2020

After three successful international PolyTrib conferences on polymer tribology, the 4th edition, PolyTrib 2020, will be organised by the Slovenian society for Tribology and Laboratory for Tribology and Interface Nanotechnology on the 28th and 29th of September 2020. The conference will return to the shores of lake Bled, which is one of the most visited spots in Slovenia, as the region is famous for its culinary scene and natural beauty. The goal of PolyTrib 2020 is to facilitate the exchange of knowledge in polymer tribology by bringing together cutting-edge research and novel manufacturing and sales practices from all over the world. The conference will host several esteemed keynote speakers and industrial exhibitions, as well as a dedicated session on polymer gears and a programme for accompanying persons. Authors are welcome to submit their abstracts by 20th of June 2020, more information is available at: www.tint-polytrib.com.

PolyTrib 2020

SLOTRIB 2020

The 14th Tribology conference organised by the Slovenian society for Tribology, SloTrib 2020, will be held as part of the 12th Industrial forum of innovation, development and technology IRT 2020. The IRT 2020 forum will take place on 8th and 9th of June 2020 in Mind Hotel Slovenija, Portorož, Slovenia, with SLOTRIB 2020 occurring on the second day, on 9th of June 2020. Welcome! For more information please visit: www.tint.fs.uni-lj.si.

University of Ljubljana
Faculty of Mechanical Engineering

Tribology and interface nanotechnology

THE 100TH ANNIVERSARY OF FACULTY OF MECHANICAL ENGINEERING AND UNIVERSITY OF LJUBLJANA

This December we commemorated an important jubilee, the 100th anniversary of University of Ljubljana and Faculty of Mechanical Engineering. The Faculty of Mechanical Engineering, which is the home faculty of Laboratory for Tribology and Interface Nanotechnology, was one of the founding members of the University in 1919 and thus played an important role in the development of science and technology in Slovenia from the very beginning. Today it is ranked as one of the top 200 faculties of Mechanical Engineering in the world. Its importance and contribution to the Slovenian society in general and the industry were reflected in the large attendance of the ceremonial commemoration event "Akademija strojništva" in Ljubljana, which attracted several esteemed guests and was organised under the sponsorship of the Slovenian president, Borut Pahor. The opening speech was given by prof. Mitjan Kalin, the dean of the Faculty of Mechanical Engineering and head of Laboratory for Tribology and Interface Nanotechnology.

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Tint

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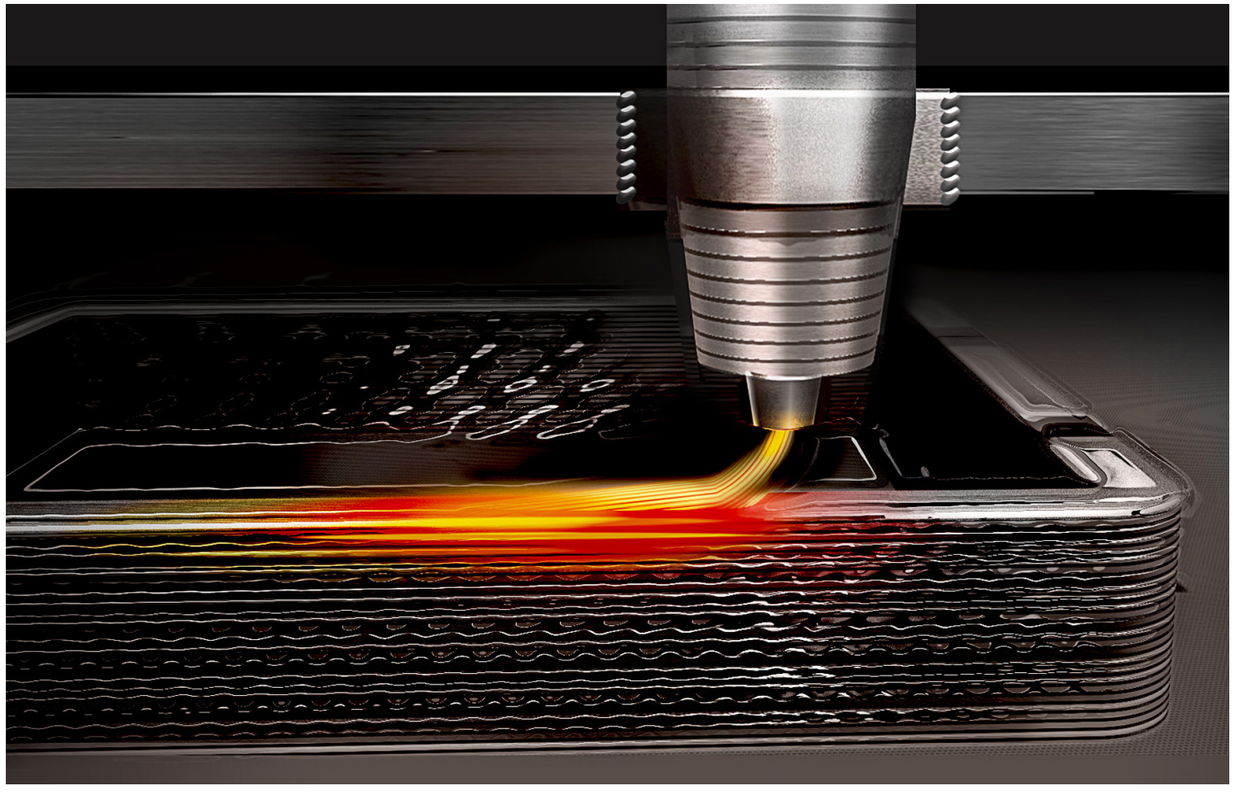
Laboratory for Tribology and Interface Nanotechnology



TRIBOLOGY OF 3D-PRINTED METAL OBJECTS

Great industrial potential for the future shows, new current methods of metal based additive technologies, which enable the production of free complex 3D geometric design also from materials that are difficult to process. 3D printed objects, typically polymeric, are moving from prototype to industrial and serial metal products for today's high-tech solutions. 3D metal print is used for the production of tools for casting, sheet metal processing, cutting and injection molding of plastic, which significantly reduce the amount of waste material, but also enable us to produce advanced internal cooling channels, an innovative efficient lubrication system and the installation of measuring sensors. They offer the production of porous and cellular structures, such as in the case of gears, housings, exhausts, cooling systems, lightweight vehicle suspension, complex hydraulic valves, connectors and cylinders that reduce weight and ensure good mechanical properties. With this type of production, we can come up with new innovative solutions that meet design and functional requirements that have not been available so far. However, in order to ensure the quality and desired properties of such products in industrial applications, knowledge of tribological and surface characteristics is also required in connection with the production parameters. Determination of wear resistance, lubrication, friction and surface integrity, tolerances, and topography are key objectives of the TINT laboratory for the adaptability of tribology of 3D printed metal products.

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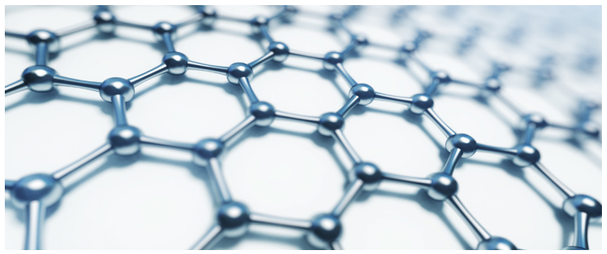
PhD DISSERTATIONS

DR. ERVIN STRMČNIK: INFLUENTIAL PARAMETERS ON OPERATING OF WATER ORBITAL HYDRAULIC MOTOR

In this PhD thesis we studied the influential parameters with respect to the operation of an orbital hydraulic motor, the main function of which is the conversion of hydraulic energy into mechanical work. The total efficiency, which depends on the volumetric and hydraulic-mechanical efficiency, was selected as the main criterion for the above-mentioned conversion of energy. Oil and water test rigs were developed and built for the two different working fluids. The result shows that the design parameters of the hydraulic motor play a very important role. The total efficiency increased up to 5 % when the hole size in the valve plate was changed. The result of a basic hydraulic test shows that the labyrinth sealing with the corresponding annular grooves can significantly reduce the internal leakage. Within the tribological tests we investigated the influence of surface roughness, surface hardness, load, and lubricant on the coefficient of friction, wear loss and wear coefficient in two contacts, i.e., (1) steel/steel and (2) DLC/steel. Considering the coefficient of friction and the wear loss, very promising tribological behaviour was observed for the SS/DLC in water. The result of the tribological test gave us the motivation for further investigations related to the DLC coating, deployed on the outer floating ring of the hydraulic motor. The maximum total efficiency of the modified hydraulic motor was 23 %. A combination of DLC, steel and water represents a promising solution for environmental sensitive applications, where oil should be replaced by water.

DR. DEJAN POLJANEC: TRIBOLOGICAL OPTIMIZATION OF AXIAL SLIP RINGS FOR AUTOMOTIVE ALTERNATROS

In the PhD thesis we have studied the influence of operating parameters on the tribological and electrical properties of the innovative design of sliding electrical contact. A dedicated tribological test rig was developed for this purpose, and is also presented in this thesis. Out of the initial eight graphite materials, three graphite materials were selected under the demanding operating conditions and were further tested and studied in detail. They were running against self-mated contacts and against copper. In all conditions, a specific surface film formation was detected, which have a key effect on the properties of the sliding electrical contact. Smooth, well-compacted film, that overlaps most of the contact, usually gives good tribological properties and stable contact operation. With graphite/graphite combinations better tribological and electrical properties than with graphite/copper combinations can be achieved. The chosen polymer-bonded graphite has proved to be the most suitable, both in pair with copper, and especially in contact with itself. The direction of the electrical current has no influence on the behaviour of the graphite/graphite combinations. Meanwhile, in the case of the graphite/copper combinations, the negative graphite surfaces wear more than the positive graphite surfaces, and the positive copper surfaces wear more than the negative copper surfaces. The results demonstrate the great potential of graphite/graphite material combinations in the disc-disc sliding electrical contact, as it is possible to achieve a good efficiency of the contact and very low wear.



DR. MAJA KUS: INFLUENCE OF DYNAMIC WETTING ON FRICTION

In the PhD thesis we have studied the effect of different organic friction modifiers on wetting with oil and consequently on elasto-hydrodynamic friction reduction. The theoretical background shows that, currently, the role of wettability in tribological applications is still not fully understood, especially with regard to wettability with lubricating oils, which exhibit the so-called spreading wetting behaviour in contact with most metals. The results show that the dynamic parameters are more suitable for wetting characterization in real tribological applications than the static ones. The results of surface energies and ATR-FTIR spectroscopy show that all tested additives adsorbed to the steel surface at both 25 °C and 100 °C, and that the adsorbed film significantly increases the oleophobicity of the surface. The Quartz Crystal Microbalance with Dissipation monitoring (QCM-D) results confirm that the tested additives adsorbed from oil on steel at both 25 °C and 100 °C, and that the adsorption is governed by the polarity of the additive. Variations in the molecular structure of the additive (number of polar groups, alkyl chain length, polarity of the functional head-group, saturation) also affects oleophobicity, the trends are the same at 25 °C and 100 °C, this influence being most evident with dynamic wetting parameters. The results of tribological tests in the EHD lubrication regime at 25 °C and 100 °C show that the tested additives reduce the friction coefficient even under when the surfaces are completely separated by the lubrication film. The coefficient of friction decreases with increasing oleophobicity of the adsorbed film. Only with the addition of organic friction modifiers to the base oil that have the ability to adsorb to the steel surface, we have reduced the coefficient of friction up to 12.4 % at 25 °C and up to 22.2 % at 100 °C, which presents an important technological contribution.

NEW PREMISES

LABORATORY FOR FLUID POWER AND CONTROLS

Laboratory for fluid power and controls (LFT) has moved after 46 years of operation to new, larger facilities. Until now, LFT was operating on the ground floor of the new FS building and has now been relocated to the basement of the old FS building at the same address. LFT facilities were officially opened on November 21, 2019, by the Dean of the Faculty, prof. dr. Mitjan Kalin and Head of LFT, Assist. dr. Franc Majdič. Many industry representatives and FS employees were present at the inauguration. The new premises are now 30 square meters larger than the old ones, which is a lot for the current situation. The opening ceremony was followed by a tour and relaxed conversations.

CONFERENCES

In 2019 representatives of the TINT laboratory attended the following conferences, where they presented their contributions and at three of them participated as invited lecturers. Leeds-Lyon 2019 (Lyon, France), EcoTrib 2019 (Vienna, Austria), Tribochemistry Hakodate 2019 (Hakodate, Japan), 3rd International Conference on High Performance Plastic Gears and Gear Production 2019 (München, Germany), IBERTRIB and RIVA 2019 (Seville, Spain), STLE 2019 (Nashville, USA), CREST International Symposium on Optimization of Running-in for Low Friction Nano-interface (Nishitetsu Inn Fukuoka, Japan). Prof. dr. Mitjan Kalin also held an International Workshop Contact Mechanics and Friction - foundations and applications in October 2019 in Berlin, Germany.

PROMINENT PUBLICATIONS

B. Brodnik Žugelj, M. Kalin

Submicron-scale experimental analyses of the multi-asperity contact behaviour of various steels, an aluminium alloy and a polymer

Tribology international. Jan. 2020, vol. 141, p 1-8.

M. Kalin, M. Polajnar, M. Kus, F. Majdič

Green Tribology for the Sustainable Engineering of the Future

Strojniški vestnik - Journal of Mechanical Engineering 65 (2019) 11-12, 709-727

J. Kogovšek, M. Kalin

Lubrication performance of graphene-containing oil on steel and DLC-coated surfaces

Tribology International. Vol. 138, October 2019, p. 59-67.

D. Poljanec, M. Kalin

Effect of polarity and various contact pairing combinations of electrographite, polymer-bonded graphite and copper on the performance of sliding electrical contacts

Wear. Vol. 426–427, Part B, April 2019, p. 1163-1175.

E. Strmčnik, F. Majdič, M. Kalin

Influence of a Diamond-Like Carbon-Coated Mechanical Part on the Operation of an Orbital Hydraulic Motor in Water

Metals 2019, 9(4), 466