

AWARDS and ACKNOWLEDGMENTS

FACULTY OF MECHANICAL ENGINEERING AWARD FOR QUALITY PUBLICATIONS

Dr. Janez Kogovšek, dr. Rok Simič and dr. Aljaž Pogačnik of the Laboratory for Tribology and Interface Nanotechnology received the Faculty of Mechanical Engineering award for researchers under 35 for their contributions in the previous academic year. They received the award for being published in internationally acclaimed SCI-index scientific journals.

FACULTY OF MECHANICAL ENGINEERING AWARD FOR RESEARCH VISIBILITY

In 2013, **Marko Polajnar** achieved great success with presenting the findings of his research and scientific efforts on an international scale by publishing two of his original scientific articles and presenting his research at conferences. In 2013, he co-authored two scientific articles (published by Tribology International and Tribology Letters). It is worth noting that his article for Tribology Letters was approved for publication in record time, highlighting the significance and relevance of the topic covered therein. In addition, he also presented his research findings with two contributions at the World Tribological Conference (WTC, Torino, 2013), the world's largest conference specialising in tribology, which only takes place every four years. Since then, he has presented his findings as a guest speaker at several other conferences abroad.

FACULTY PREŠEREN AWARD FOR RESEARCH IN 2013

Blaž Žugelj, researcher at the Laboratory for Tribology and Interface Nanotechnology, was awarded the faculty Prešeren award for his paper titled *"The Influence on Surface Charge on Tribological Behaviour of SiC and Si₃N₄ Ceramics Lubricated with Water"*.



University of Ljubljana
Faculty of Mechanical Engineering



Tribology
and interface
nanotechnology

COMING UP

INTERNATIONAL CONFERENCE ON POLYMER TRIBOLOGY - POLYTRIB 2014, 11th -12th SEPTEMBER 2014, HOTEL ASTORIA, BLED

The 1st International conference on polymer tribology, PolyTrib 2014, will address the tribological challenges of polymer materials and associated aspects regarding the industrial applications, their design and modeling, materials selection and properties, manufacturing issues, recent advancements, growth potential and others.

Researchers and specialists in development and manufacturing, as well as users and those in sales sector, dealing with polymer materials for tribological applications are invited to participate and exchange the experience, knowledge and problems, and so develop new scientific, professional and commercial contacts and strengths. Contributors are invited to submit short abstracts (200 words) to the following e-mail address: polytrib@tint.fs.uni-lj.si.

More information at:
www.tint-polytrib.com.



CONFERENCE ON TRIBOLOGY, LUBRICATION AND TECHNICAL DIAGNOSTICS – SLOTRIB 2014, 11. 11. 2014, LJUBLJANA

The Slovenian Society for Tribology is organising the 13th international professional consultation on tribology, lubricants and technical diagnostics. This year's event is dedicated to new tribological challenges in order to expand the traditional notion of tribology. Though some of the topics may be better suited for the future, it sometimes serves to think outside of the box as defined by the current state of affairs. Researchers and experts in development and manufacturing as well as private sector employees are cordially invited to the one-day event. The SLOTRIB conference will take place on 11 November 2014 in Ljubljana, Slovenia, at the Slovenian Chamber of Commerce hall.

CONTACT

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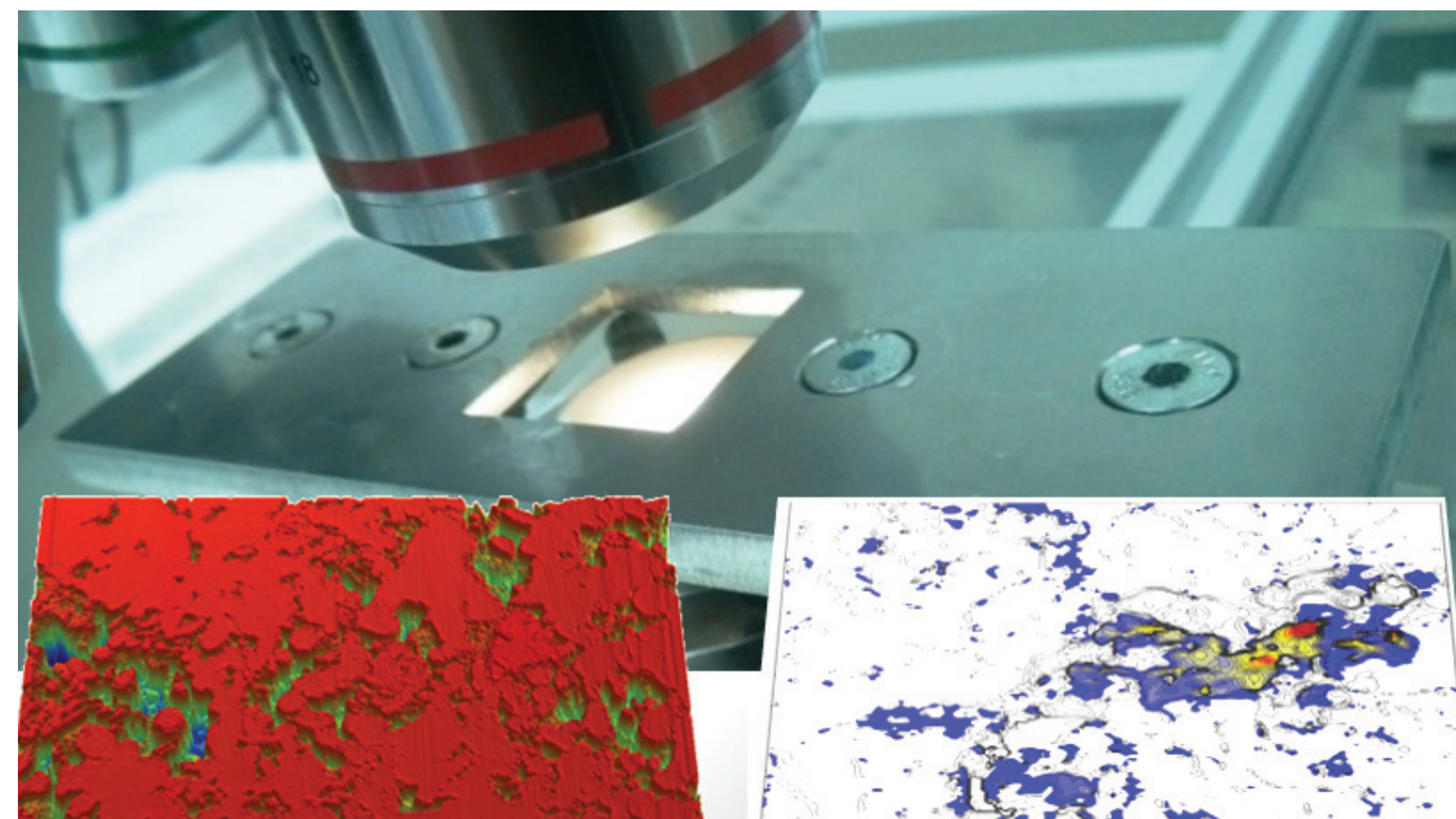
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Laboratory for Tribology and Interface Nanotechnology



CONTACT ENGINEERING is based on modifying surface and contact properties as the use of surface technologies

Modern mechanical components and systems need to meet increasingly stringent functionality requirements while ensuring high efficiency, quality, durability, low energy consumption and its status as green technology. **Functional surfaces** have risen in importance as the key link between mechanical elements, protection for materials and the link between contact parts and the environment. Functional surfaces are the first to enter into contact and transfer the sum of the energy between engineering components as well as loads. To choose the right type and ensure the functioning of the entire system, precise control of parameters is needed on the macro scale, while understanding and controlling nano-scale behaviour. This is made possible by **contact engineering**, which includes roughness, topography, surface structure, surface energy, wettability, adhesion, surface coatings and layers, lubricants and in situ boundary films.

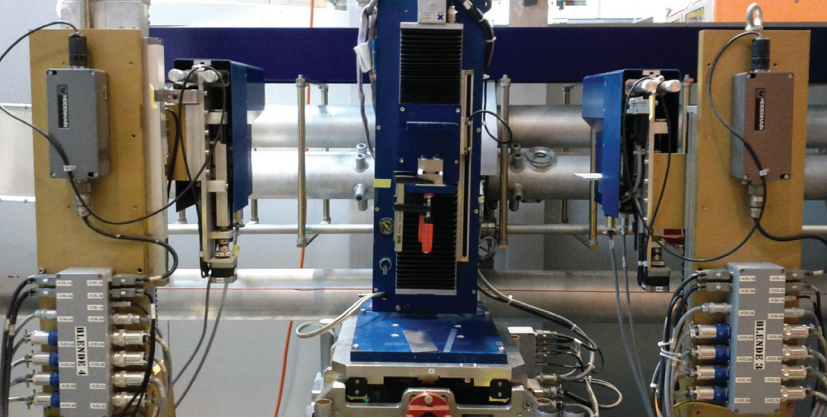
Drawing from its extensive, detailed knowledge and a wide range of experience with practical industry cases both at home and abroad, TINT provides contact engineering solutions for the most challenging mechanical systems.

www.tint.fs.uni-lj.si

PhD DISSERTATIONS

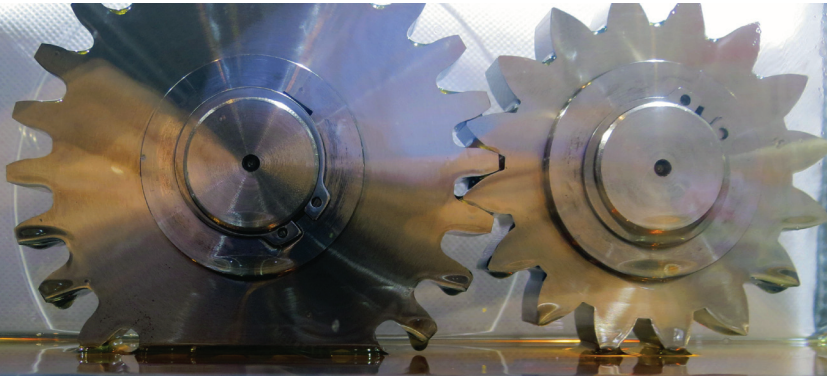
DR. ROK SIMIČ: NANOTRIBOLOGY OF CHEMICALLY AND PHYSICALLY ACTIVE ADDITIVES ON DIAMON-LIKE CARBON COATINGS

The doctoral thesis addresses the two options of lubrication of diamond-like carbon (DLC) coatings; by conventional lubrication by adsorption of polar molecules as chemically active additives or by innovative lubrication using nanoparticles as physically active additives. The effect of both additive types on friction and wear of DLC coatings was evaluated. The addition of polar molecules of alcohols and fatty acids proved highly effective, as it lowered the wear of coatings by as much as 20%, thereby significantly extending its life cycle. Using various surface-sensitive methods, the adsorption mechanisms of fatty acids and alcohols on DLC coatings was studied on the nano scale, and their impact in DLC coating contact explained. Potential adsorption mechanisms on DLC surfaces with regard for the effect of the environment, temperature and tribological contact were proposed.

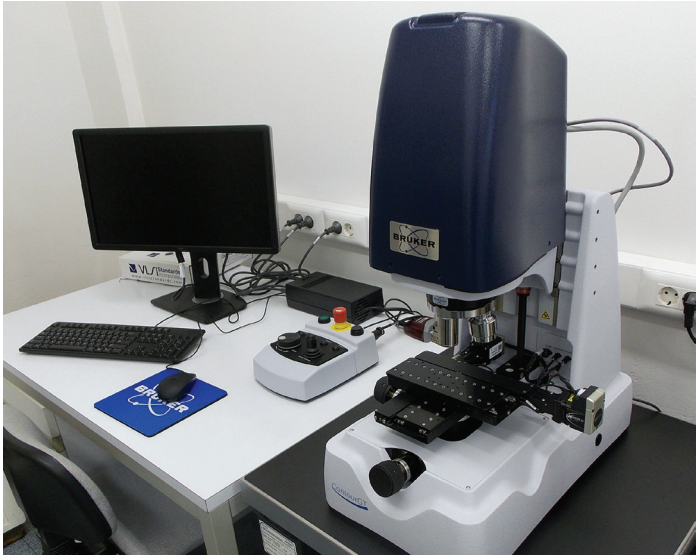


DR. BORIS KRŽAN: INVESTIGATION OF TRANSMISSION OPERATING WITH REDUCED QUANTITY OF LIQUID LUBRICATION

In the thesis, the load-carrying capacity and surface fatigue life of standard case hardened gear set is compared with the gear system coated with tungsten doped diamond like carbon (W-DLC) protective film applied on the tooth flanks. Tests were conducted on laboratory four-square gear test rig with reduced oil level that corresponds to an immersion depth of three times the modulus of the gear. About **2-fold higher load-carrying capacity and 3-times longer pitting fatigue life** was found for W-DLC coated gears in comparison with the standard case carburized gears lubricated with the high-quality conventional gear oil of the similar viscosity.



NEW EQUIPMENT



3D OPTICAL INTERFEROMETER – BRUKER – CONTOURGT-K0

Optical interferometer enables observation of 2D and 3D surface topography roughness parameters, wear volumes, transfer films etc.

- Operation mode: white or green light interferometry
- Scanning range (X-Y: area): 30 mm x 30 mm
- Scanning range (Z: vertical): 10 mm
- Resolution: lateral - 40 nm; vertical - 0.1 nm
- Automatic stitching of several pictures for large samples

PROMINENT PUBLICATIONS

R. Simič, M. Kalin, T. Hirayama, P. Korelis, T. Geue

Fatty acid adsorption on several DLC coatings studied by neutron reflectometry

Tribology Letters 53, 199-206, 2014

M. Kalin, M. Polajnar

The wetting of steel, DLC coatings, ceramics and polymers with oils and water: The importance and correlations of surface energy, surface tension, contact angle and spreading

Applied Surface Science 293, 97-108, 2014

M. Kalin, J. Kogovšek, M. Remškar

Nanoparticles as novel lubricating additives in a green, physically based lubrication technology for DLC coatings

Wear 303, 480-485, 2013

A. Pogačnik, T. Požar, M. Kalin, J. Možina

A homodyne quadrature laser interferometer for micro-asperity deformation analysis

Sensors 13, 703-720, 2013

SELECTED PROJECTS

MATERA SINACERDI - MATERIALS FOR HIGH WEAR APPLICATIONS

The goal of the SiNACERDI project is to develop new nanocomposite and locally alloyed braking discs for ceramic disc brakes. To this end, we and our partners are developing a highly wear-resistant material with a stable, constant friction coefficient under the harshest operating conditions. We have been carrying out research into nanoceramic and nanocomposite materials with an aluminium base and solid silicon-based (Si_3N_4) nanoparticles and the impact of micro-alloying on the tribological properties of the nodular alloy in order to optimise local alloying technology for thermally treated nodular alloys.

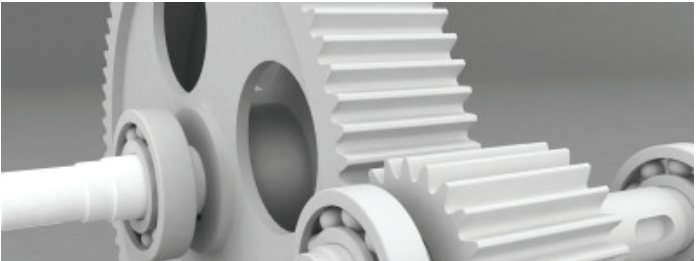
Partnerji: ZORNIK d.o.o. (Slovenia), SUT (Poland), IceTec, FTJ (Iceland), CTP-GL (Luxembourg)



NANOPARTICLES-REINFORCED POLYMER COMPOSITES FOR HIGHLY-LOADED MECHANICAL COMPONENTS

The project focuses on studying the formation and efficiency of tribological surface boundary films in contacts of a new polymer composite with a poly-ether-ether-ketone (PEEK) base. The nanocomposite will be designed for operation in environments with no extra lubrication by using self-lubricating MoS_2 and WS_2 nanoparticles. The development of the polymer composite by planning tribological boundary layers aims for its application in hi-tech products requiring a low mass of mechanical components as well as state-of-the-art mechanical and tribological properties.

Partnerji: IJS (Slovenia), Weizmann Institute of Science (Israel), CNRS (France)



CONFERENCES

STLE ANNUAL MEETING 2014 (Orlando, ZDA)

The 69th Society of Tribologists and Lubrication Engineers (STLE) conference took place in May 2014 in Florida, United States. The annual STLE conference is one of the largest international conferences on tribology and lubrication. Over 300 articles, applied case studies and examples of good practice were presented over the five-day period; the event also featured a round table discussion on technical market trends in lubrication. Prof. Kalin was in attendance and presented an article titled “Influence of Surface-Oil Polar Interactions on Friction Performance”, which presented the leading findings related to the interconnectedness between surface energy and friction. The topic attracted significant interest in the scientific and professional community. Prof. Kalin also acted as member of a committee for selecting the best poster by a postgraduate student.

FAIR SHOWCASE

REMOTE-CONTROLLED HYDRAULIC ARM

As part of the Terotech Fair (20-23 May 2014), the Laboratory for Fluid Power, with co-funding by sponsors, developed and presented a special remote-controlled hydraulic arm. The hydraulic arm is made of light materials, easily disassembled and takes up little space when in operation. Its selling point is its ability to rotate 360 degrees, owing to its high-performance low-flow hydraulic engine, which was developed in a laboratory and a partner company. Its shaft powers three cost-efficient conventional directional control valves and, indirectly, three hydraulic bats. The arm can lift a load up to 2.2m high and rotate over a circle with a diameter of 3.6m. The arm attracted a large number of visitors over the four days of the fair. The biggest fans could try it out by lifting chunks of spruce firewood.

