

TRIBOS - JOINT EUROPEAN MASTER OF SURFACES AND INTERFACES

The first generation of TRIBOS programme students commenced their studies in September 2013. Out of 161 applicants, 15 students from 11 countries (Slovenia, Croatia, Albania, Turkey, Russia, Ethiopia, Indonesia, Iran, China, India and Pakistan) were selected. The students have already begun their studies at the University of Leeds, UK, and will be welcomed to the University of Ljubljana, Slovenia, in January 2014. Applications for the second generation of TRIBOS students have begun in November 2013.

More information available at:
info@master-tribos.eu, www.master-tribos.eu

AWARDS and ACKNOWLEDGMENTS

FACULTY PREŠEREN AWARD FOR RESEARCH IN 2012

Eva Oblak, a researcher at **Laboratory for tribology and interface nanotechnology** was awarded the Faculty Prešeren award for her research work in 2012. She received the award for a project titled: *Determination and evaluation of boundary lubrication films on nonconventional materials with atomic force microscope.*

FACULTY OF MECHANICAL ENGINEERING AWARD FOR QUALITY PUBLICATIONS

Dr. Marko Sedlaček, a researcher at the **Laboratory for tribology and interface nanotechnology**, received the Faculty of Mechanical Engineering award for researchers under 35 for his outstanding publications in 2012. He received the award for publishing four articles in internationally acclaimed, SCI-indexed scientific journals.

GOLDEN DIPLOMA

An award for the best thesis related to fluid power of the last two years was awarded at the FLUID POWER 2013 international conference. It was awarded to graduate Alen Ljoki of the **Laboratory for Power-Control Hydraulics** for his thesis titled: *The analysis of a gerotor hydraulic motor.*



JOŽEF STEFAN GOLDEN EMBLEM 2013

Dr. Marko Sedlaček was awarded a highly recognized in Slovenia Jožef Stefan Golden Emblem of 2013 for his doctoral dissertation *Influence of surface topography on tribological behaviour of contact surfaces.*

GOLDEN GUILD 2013

At the International Trade Fair in Celje the Chamber of Craft and Small Business of Slovenia awarded the Golden Guild Award to the company KGL d.o.o. for its power-control hydraulics developed in cooperation with the **Laboratory for Power-Control Hydraulics**, a member of the Chair of Tribology and Maintenance Systems. The drive is used to power and manipulate frames used in biomass harvesting and production, recycling and sorting waste, in agricultural and forestry machinery. Its modular hydraulic drive concept is an innovative approach to the development, production and application of this type of drives and a basis for the development of high-momentum low-flow shaft-mounted drives.



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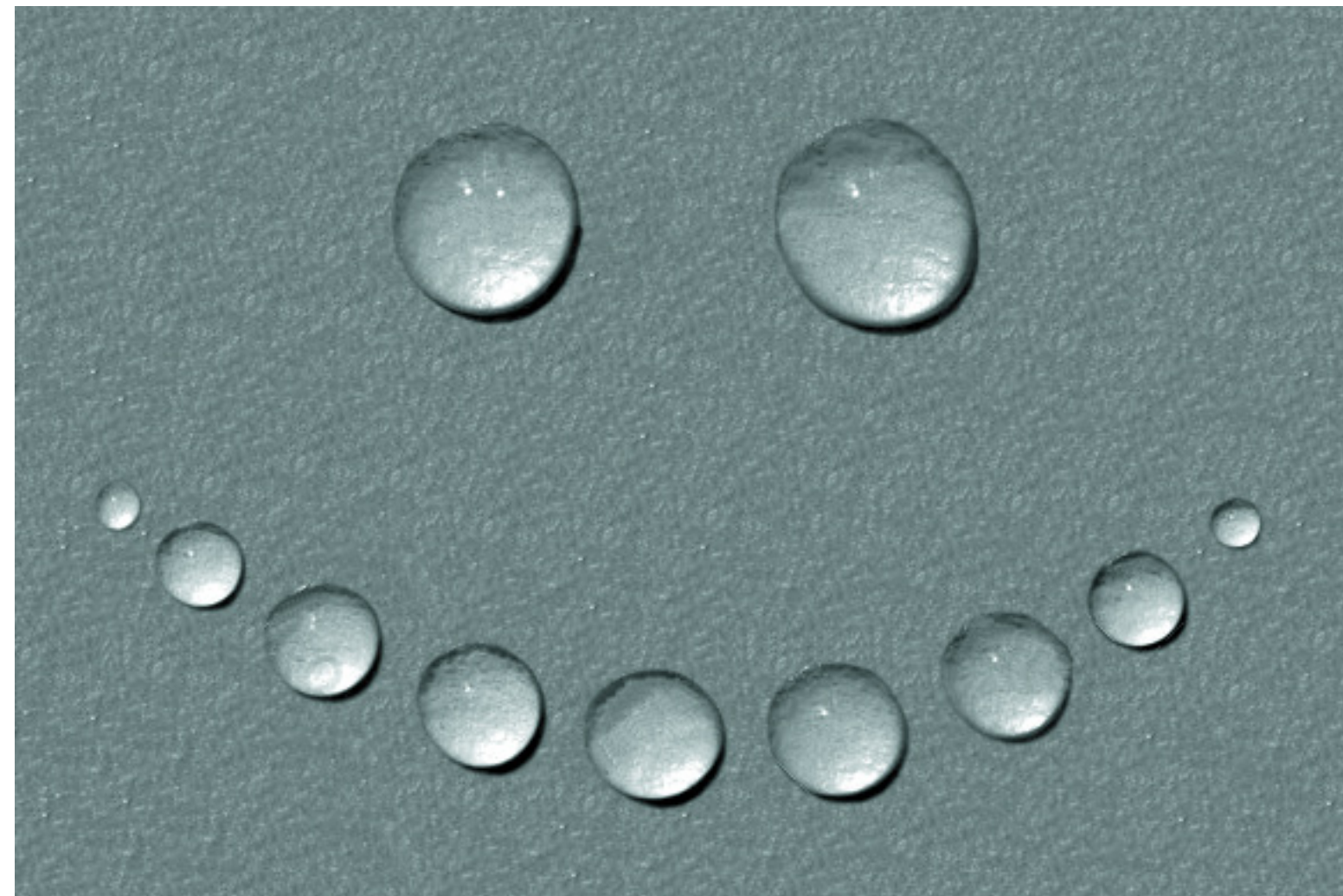
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Laboratory for Tribology and Interface Nanotechnology



PROPERTIES OF THE SOLID-LIQUID INTERFACE have a decisive effect on tribological and other surface properties

For the last couple of years, LABORATORY FOR TRIBOLOGY AND INTERFACE NANOTECHNOLOGY - TINT has been intensively involved in the study of the effect of surface energy and wettability on tribological contact properties, friction in particular. Our surprising results have stimulated research groups worldwide – we demonstrate that a favourable combination of free surface energy of the surface and the lubricant can reduce friction by over 30%. We also uncovered new correlations between wettability and surface energy for a variety of materials (steel, ceramics, surface coatings, polymers) as well as lubricants and water. Our latest findings are available to the public in several articles in scientific literature.

www.tint.fs.uni-lj.si



NEW EQUIPMENT

CLIMATE CHAMBER WEISS 300/40

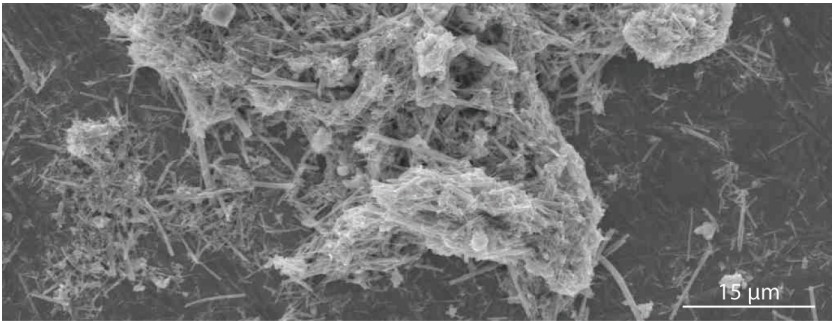
The climate chamber allows us to modify environmental conditions when running tribological experiments with pre-set programmes. The chamber can be used in combination with different tribometers and surface wettability measuring equipment. It boasts the following characteristics:

- Temperature range: -40 °C to 180 °C
- Relative humidity range: 10 % to 98 %
- Heating/cooling rate: 4 K/min

PhD DISSERTATIONS 2013

DR. JANEZ KOGOVŠEK: TRIBOLOGICAL EFFECTS OF NANOPARTICLES IN LUBRICANTS

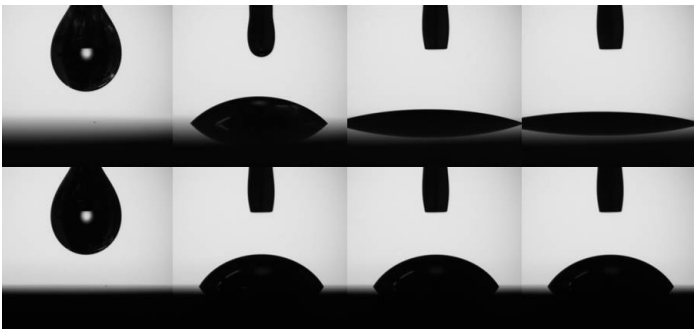
The doctoral dissertation addresses the impact of MoS₂ nanotubes added to oil on the lubrication of various contacts. We demonstrated that the use of the MoS₂ particles enables the highest reduction in friction and wear in comparison to WS₂ and carbon particles. Lubrication with the MoS₂ nanotubes is based on a tribofilm formation and purely physical rather than chemical effects of the particles. The effectiveness of the MoS₂ nanotubes on steel may reduce the need for surface finishing. The use of MoS₂ nanotubes in lubrication of surface coatings even further reduces friction. The structure and function of the tribofilm are the same with steel and surface coatings, making the use of MoS₂ nanotubes a promising green lubrication technology.



DR. ALJAŽ POGAČNIK: EFFECTS OF PHYSICAL PARAMETERS ON TRIBOLOGICAL PROPERTIES OF POLYMERS FOR GEARS

The doctoral thesis analyses the effect of different physical parameters (normal load, sliding speed, temperature) on friction, wear and wear mechanisms of polymer materials commonly used for gears. Wear maps and critical contact conditions were determined from extensive tribological investigation of 8 different material combinations of PA, POM and steel. With the analysis of theoretical contact temperatures, worn surfaces and changes in tribological mechanisms, several mechanical and thermal parameters are introduced in order to evaluate the effect of physical parameters on the crucial changes of the wear mechanism of polymer materials. The real contact area of polymer materials was determined using asperity-peak deformation measurements and also with the analysis of plastically deformed polymer surfaces.

HIGH and LOW WETTABILITY



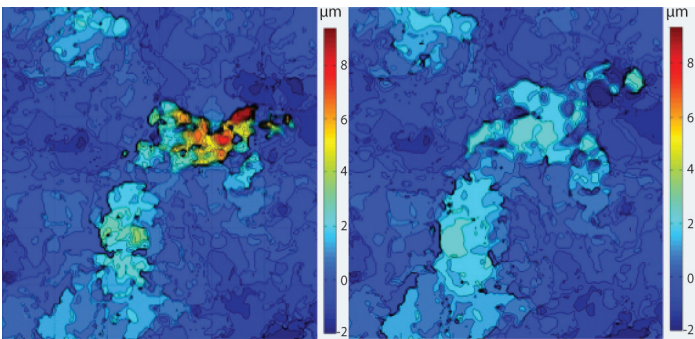
CONFERENCES

TRIBO-LYON 2013

In September 2013, the 40th tribological and tribochemical conference took place in Lyon, France. Over 200 papers were published at the conference as posters or presentations, with over 300 people in attendance, including the most prominent tribology, tribochemistry and tribological computer simulation researchers, which serves to prove its quality and impact. TINT employees attended the conference with an acclaimed article: »*Adsorption of polar molecules on DLC coatings*« and a poster titled »*Neutron reflectometry of adsorbed additive layer on (a-C) DLC.*«

ECOTRIB 2013 - A TRACK WITHIN WTC, TORINO

The European tribology conference ECOTRIB, organised biannually by the Slovenian Society for Tribology in cooperation with tribological societies from Austria, Switzerland and Italy, took place in Torino, Italy, between 8th and 13th of September. This year's conference, was organised by Mitjan Kalin as a World Tribology Congress track. World Tribology Congress takes place every four years and is the world's largest tribology conference both in terms of attendance and the number of contributions. The conference saw over 1100 paper presentations, 7 of them authored by members of Laboratory for Tribology and Interface Nanotechnology.

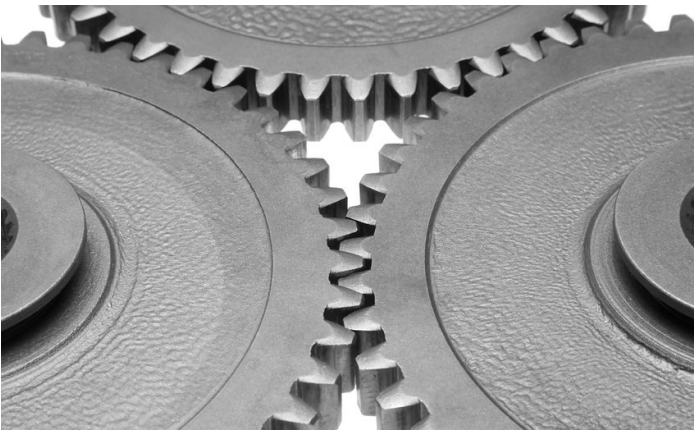


SELECTED PROJECTS

MAZARO - INOVATIVE TRANSMISSION

In 2012 and 2013, we collaborated with the Belgian company Mazaro Driving Innovations on their project of developing a friction transmission for cars called "Reversible Variable Transmission". We coordinated the tribological optimisation for the project. The project involved a comprehensive contact engineering for drive discs to achieve the highest possible friction during power transmission with minimal wear on the discs. We selected and optimised the friction fluid, the material and topography of the drive discs and the thermal treatment and hardness of contact surfaces. The results allowed us to determine the key parameters for increasing friction both on the surfaces themselves as well as in the tested types of friction fluids.

Partners: Mazaro Driving Innovations (Belgium), Uddeholm (Sweden), Lubrizol (UK).



PROMINENT PUBLICATIONS

M. Kalin, R. Simič

Atomic force microscopy and tribology study of the adsorption of alcohols on diamond-like carbon coatings and steel
Applied Surface Science 271, 317-328, 2013

M. Kalin, M. Polajnar

The correlation between the surface energy, the contact angle and the spreading parameter, and their relevance for the wetting behaviour of DLC with lubricating oils
Tribology International 66, 225-233, 2013

J. Kogovšek, M. Remškar, M. Kalin

Lubrication of DLC-coated surfaces with MoS₂ nanotubes in all lubrication regimes: Surface roughness and running-in effects
Wear 303, 480-485, 2013

ENTICE - ENGINEERING TRIBOCHEMISTRY AND INTERFACES WITH FOCUS ON THE INTERNAL COMBUSTION ENGINES

The ENTICE project focuses on a comprehensive analysis of the tribochemistry in internal combustion engine lubrication systems, with a special emphasis on the new environmental regulations. The project sets the following scientific and technological goals:

- The development of models explaining the function of additives in tribological behaviour on the nano and macro scale.
- Optimised interactions on the material lubricant level to achieve low friction and durable internal combustion engine components.
- The design of new-generation in-contact tribological/tribochemical measuring techniques for the chemical characterisation of the tribological contacts.
- Tribochemical study of the methodologies relevant for internal combustion engines.
- The development of an expandable computer network on several scales that will include real surface, microstructures and the dynamic surface modification.

Partners: Mercedes Benz HPE Ltd. (UK), TOTAL Raffinage Marketing (France), SKF Engineering Research Centre (Netherlands), Sulzer Sorevi (France), Ecole Centrale de Lyon (France), University of Leeds (UK), AC2T (Austria).

COMING UP

THE 1st INTERNATIONAL CONFERENCE ON POLYMER TRIBOLOGY, POLYTRIB 2014, 11th – 12th September 2014, Bled, Slovenia

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. More information: www.tint-polytrib.com

Content: Friction and wear of polymer materials, polymer materials for tribological applications, polymer composites and nano-composites, tribo-chemical investigations of polymers, lubrication of polymers and boundary layers, adhesion, interfaces, wetting and surface energy, topography and surface integrity, environmental aspects of polymers and relation to tribology, numerical simulations, nanotechnology in polymer tribology, testing techniques and methodology.

SLOTRIB 2014

The Slovenia Society for Tribology and the Laboratory for Tribology and Interface Nanotechnology (TINT) are organising the traditional SLOTRIB 2014 conference in November 2014 in Ljubljana. The single-day event will see industry and academic experts present current issues related to tribology, lubricants, technical diagnostics, alternative fuels and ecology.