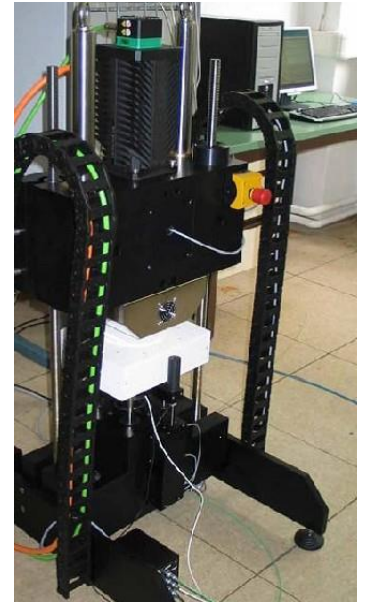
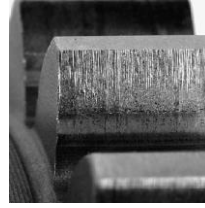


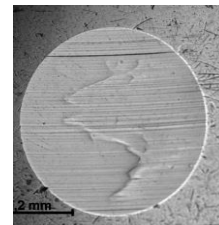
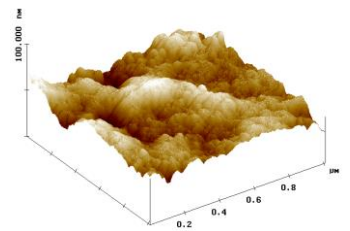
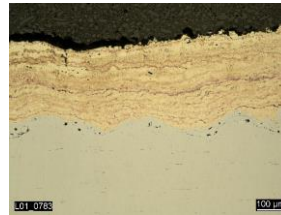
# LABORATORY OF TRIBOLOGY

**Activity of laboratory** – research of tribological processes in mechanical and mechatronic systems (analysis of friction, wear, lubrication factors and its interaction in friction pairs). Two scientific work groups are in laboratory: 1) oils and greases, 2) wear resistant surfaces and coatings.



## Research topics:

- Tests of lubricating materials properties (oils, greases): tribological properties, penetration of plastic lubricants, drop point of plastic lubricants, flash point of oils, biodegradability etc.;
- Friction and wear reduction ability of lubricants and coatings;
- Tribological properties of tribopairs in ultrasonic (piezoelectric) actuators;
- Comparable abrasive wears tests of structural materials – wear in abrasive mass, wear at moderate and high contact pressure, wears on abrasive paper;
- surface mechanical properties investigation, surface roughness, micro-structure, including:
  - Evaluation of macro and micro geometric parameters of machinery elements;
  - Hardness (microhardness) and scratch tests;
  - Optical microscopy;
  - Surface roughness investigation;
  - AFM investigation.



## Research facilities and equipment

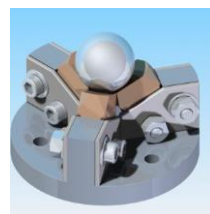
Equipment for investigation of tribological properties of materials:

- Tribometer (TRM 500) suitable for rotating, vibrating and reciprocating movements, designed for friction pairs Pin-on-disc, Ball-on-disc, and additional modules for low (up to -40 °C) and high (up to 600 °C) temperatures;
- Tribometer MAST-1 for 4 balls tests;
- Tribotester for excursion movement of piezoelectric friction pairs (ASU original design);
- Tribotester for wear in abrasive mass (ASU original design).



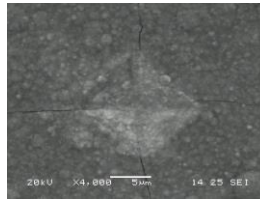
Investigation of lubricants:

- Preparation of biological oils and greases (rapeseed, sunflower, lard etc.). Its modification with nano-particle additives;
- Investigation of drop-point (ASTM D 566–97 standard), flash point measurements (Humboldt H-2085.4F device), and penetration measurements (Humboldt H-1240D.4F device according to ASTM D 217-97 standard) and aging (oxidation) of the bio-oils and greases;
- Lubricants spectral properties (photospectrometer USB 4000-FL Ocean Optics B.V.);
- Performing of 4 ball tribological lubrication tests.



## Surface investigation:

- Profilometer-profilograph 3D (MahrSurf XR 20);
- Hardness testers, Micro-hardness tester, Micro Kombi tester (for scratch and micro-indentation) (CSM Instruments SA);
- Optical microscope, SEM with supplement for chemical analysis.



**BALTTRIB conference.** Researchers of Tribology Laboratory arrange the international scientific conference BALTTRIB every second year (since 1999). The participants of that conference are well known scientist in field of tribology from USA, Eastern and Nord Europe, Germany, Asian countries. More about BALTTRIB see: [www.balttrib.info](http://www.balttrib.info)

## Research team:

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MSc. **Albinas Andriušis**, E-mail: [albinas.andriusis@asu.lt](mailto:albinas.andriusis@asu.lt).

## Important publications in reviewed journals:

Tribological running-in investigation and surface analysis of copper coats made by electro-impulsive spraying:  
<http://int.asu.lt/RRduomenys/Straipsniai/SURFCOAT'2011-205-p.3328-3333.pdf>

The influence of oxidation on tribological properties of rapeseed oil:  
<http://int.asu.lt/RRduomenys/Straipsniai/TRANSPORT.2011.Nr.26.p.121-127-Kreivaitis.pdf>

Oxidation effect on tribological properties of rapeseed oil and lard mixtures containing monoglycerides and fatty acids:  
<http://int.asu.lt/RRduomenys/Straipsniai/EREM-2012-61-p.42-49-Kupcinskas-Kreivaitis.pdf>

Development and modification of Fe and FeCu nanoparticles and tribological analysis of the lubricants with nano-suspensions:  
<http://int.asu.lt/RRduomenys/Straipsniai/ILT-2012-64-p.253-257-Padgurskas-Prosycevas.pdf>

Modification of rapeseed oil and lard by monoglycerides and free fatty acids:  
<http://int.asu.lt/RRduomenys/Straipsniai/MECHANIKA.2012.Nr.18.p.113-118-Kupcinskas.pdf>

Tribological properties of lubricant additives of Fe, Cu and Co nanoparticles:  
<http://int.asu.lt/RRduomenys/Straipsniai/TRIBINT-2013-60-p.224-232-Padgurskas-Rukuiza.pdf>

A comparison of pure and natural antioxidant modified rapeseed oil storage properties:  
<http://int.asu.lt/RRduomenys/Straipsniai/Ind-cr-pr.2013.Nr.43.p.511-516-Kreivaitis.pdf>

Lubrication properties of modified lard and rapeseed oil greases with sodium and lithium thickeners:  
<http://int.asu.lt/RRduomenys/Straipsniai/ILT-2015-67-p.557-563-Padgurskas-Rukuiza.pdf>

Tribological performance of piezoelectric drive with rotor covered with YSZ and Al<sub>2</sub>O<sub>3</sub> ceramic coatings:  
<http://int.asu.lt/RRduomenys/Straipsniai/JFRW-2015-36-p.355-362-Padgurskas-Zunda.pdf>

Impact of the tribological characteristics on the dynamics of the ultrasonic piezoelectric motor:  
<http://int.asu.lt/RRduomenys/Straipsniai/MECHANIKA.2015.Nr.21-p.51-55-Padgurskas-Rukuiza.pdf>

Investigation of tribological properties of carbide coatings deposited by electrospark at piezoelectric tribocontact:  
<http://int.asu.lt/RRduomenys/Straipsniai/SurfEng-2015-51-pp.125-132-Padgurskas-Zunda.pdf>

Influence of manufacturing methods on the tribological properties of rapeseed oil lubricants:  
<http://int.asu.lt/RRduomenys/Straipsniai/TRANSPORT.2016.Nr.31.p.56-62-Padgurskas.pdf>

## **Most important projects:**

### **Friction pair radial seal - shaft increase in durability and wear reduction using nano-particles and metal polymeric materials.**

Partners: ASU, Hamburg-Harburg Technical University (Germany); financed by BMBF (Germany), 1995-1998.

### **Influence of shaft surface microgeometry on properties of the seal.**

Partners: ASU, Georgia Institute of Technology (USA), Cracow Technical University (Poland), Wroclaw Technical University (Poland), Hamburg-Harburg Technical University (Germany); financed by NSF (USA), 1999-2003.

### **Mechanical testing of hydraulic fluids.**

Partners: ASU, Hamburg-Harburg Technical University (Germany); financed by DGMK (Germany), 2003-2005.

### **Functional nano-structures and molecular mechanisms.**

Partners: ASU, Kaunas University of Technology (Lithuania), Vilnius University (Lithuania), Kiel University (Germany); financed by VMSF (Lithuania), 2003-2006.

### **Investigation on Electrochemically Manufactured Materials and its Tribological Properties Applying them for Micro- and Nanotechnology Products.**

Partners: ASU, Katholieke Universiteit Leuven (Belgium), Vilnius University (Lithuania), Kaunas University of Technology (Lithuania), Ecole Centrale Paris (France), Institute of Applied Physics (Moldova), V.I.Vernadsky Institute of General & Inorganic Chemistry (Ukraine); financed by INTAS (EU), 2006-2008.

### **Development of technology for processing plant oils and waste fats as components of biodegradable lubricants and fuels.**

Partners: ASU, Institute of Fuel and Renewable Energy (Poland), Air Force institute of Technology (Poland), Institute of Heavy Organic Synthesis „Blachownia" (Poland), JSC "Rapsoila" (Lithuania); financed by EUREKA (EU), 2007-2010.

### **Creation and investigation of suspensions of magnetic nano-particles for tribosystems.**

Partners: ASU, Vilnius University (Lithuania), Institute of Physics (Lithuania), Institute of Chemistry (Lithuania), Institute of Applied Physics (Moldova), Georgian Technical University (Georgia); financed by VMSF (Lithuania), 2008-2010.

### **R&D of adaptive tribological parameters control methods for piezoelectric motors (TriboPjezo).**

Partners: ASU, Kaunas University of Technology (Lithuania); financed by Lithuanian Science Council (Lithuania), 2012-2014.

### **Training and collaboration on material developments and process improvements in oil and sugar production (Oil&Sugar).**

Partners: ASU, Katholieke Universiteit Leuven (Belgium), Ecole Centrale Paris (France), Vilnius University (Lithuania), National Technical University of Athens (Greece), Istanbul Teknik Universitesi (Turkey), Institute of Applied Physics (Moldova), Université Moulay Ismail (Morocco), Sfax University (Tunisia); financed by FP7 IRSES (EU), 2012-2016.

## **Patents**

United States Patent US 8,297, 104 B2, Oct. 30, 2012 **Device for measuring the influence of friction force on the wear characteristics of material surface** / J.Padgurskas, A.Andriusis, ASU; 20121130, 7 p.

Patent LT 6206 B **Contact zone diagnostic device for piezoelectric motors** / J.Padgurskas, R.Bansevičius, A.Bubulis, V.Jurėnas, A.Andriušis, A.Žunda. ASU; Vilnius, 20150825. 7 p.

United States Patent US 9,134,214 B2, Sep. 15. 2015 **Device for measuring the influence of friction force on wear characteristics of a material surface with high frequency loading force** / J.Padgurskas, A.Andriušis, ASU; 20150915, 6 p.

German Patent DE 112009000454 B4, 2016.07.21, **Vorrichtung zum Messen des Einflusses der Reibkraft auf die Verschleißeigenschaften einer Materialoberfläche** (Device for the measurement of the influence of friction force on the wear characteristics of material surface) / A.Andriusis, J.Padgurskas, ASU; 20160721, 5 p.

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