



Science and industry cooperation within the activity of CAT AERONET Aviation Valley

Rzeszów, October 21-22, 2008

Prof. Romana Ewa LIWA
Rzeszów University of Technology
Centre of **Advanced Technologies AERONET Aviation Valley**, Rzeszów

Topics

- **Research capacity in aeronautics**
Innovation Centers and Technological Parks in Poland
Centres of excellence and centres of advanced technologies
- **The system of research and implementation of innovation and technology in Poland**
- **CAT AERONET Aviation Valley**
- **Materials Laboratory in Rzeszow**

The system of research and implementation of innovation and technology in Poland

- **Research networks;** *They are formed as joint structure of regional research and education centres,*
 - **Maria Curie Centres,**
 - **Centres of Transfer of Technologies - CTT,**
 - **Technology and Research Parks,**
 - **Incubators,**
 - **Pre-incubators**
 - **Centres of Excellence**
- additionally*
- **22 technological platforms**

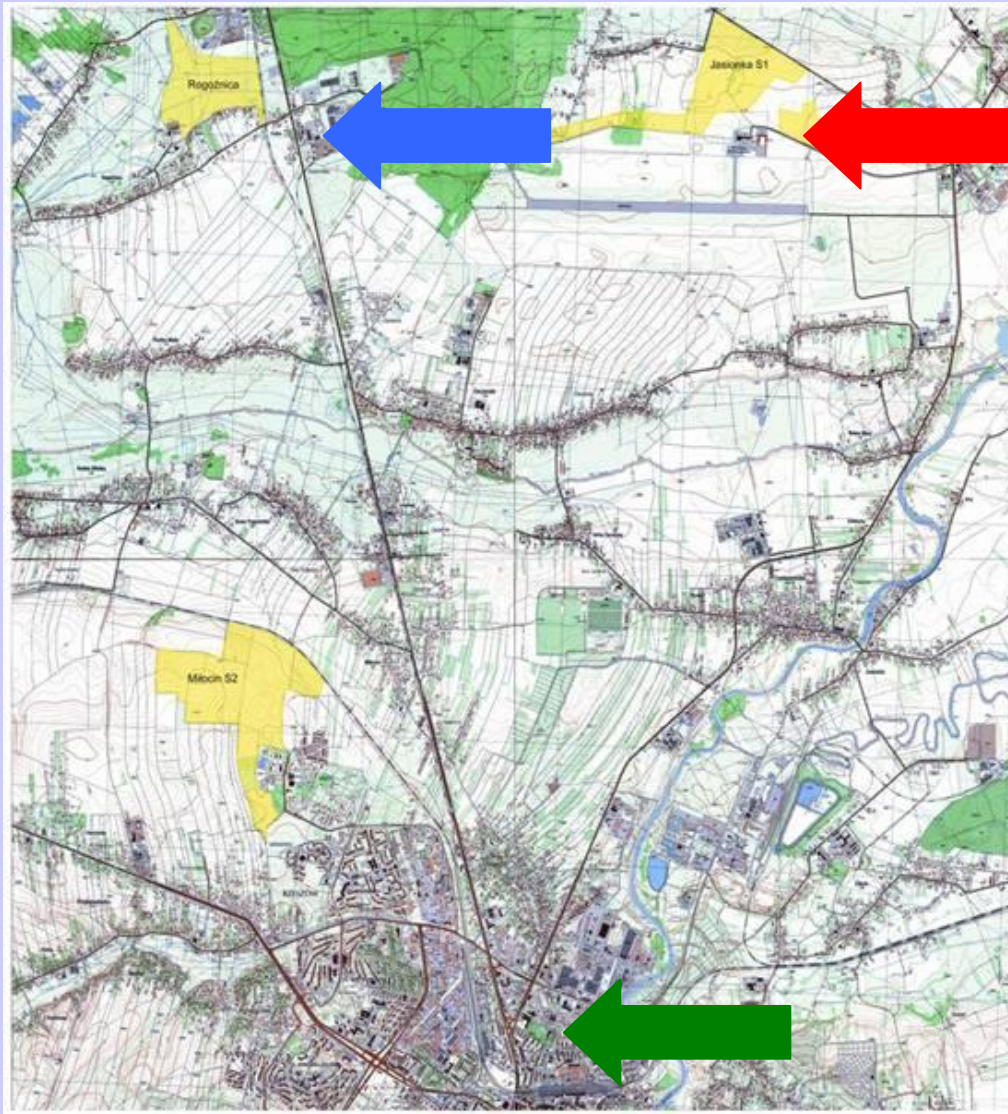
Polish Technological Platforms

- **PP of Materials**
- PP of Innovative Medicine
- PPT of the Internal Security
- PPT of Work Safety in the Industry
- PPT of the Biotechnology
- PPT of Construction
- **PPT of Aviation**
- PPT of Metals
- PPT of Environmental Protection
- PPT of Opto- and Nanoelectronics
- PPT of Production Processes
- PPT of The Textile Industry
- PPT of Forestry and wood
- PPT of Safety
- PPT of Communication and mobile Technologies
- **PPT of Road Transport**
- **PPT of Rail Transport**
- **PPT of Water Transport**
- PPT of Hydrogen & Fuel Cells
- PPT of Sustainable Chemistry
- PPT of Sustainable Energy Systems & Clean Carboenergy
- PPT of Food



An example of Technology and Research Park near Rzeszów

Location and zones of the Park



S1 zone - situated around Rzeszów Jasionka Airport; 70 hectares, green-field,

S2 zone - situated in the Glogow Community, 47 hectares, green-field,

S3 zone - Academic Preincubator located on the area of Rzeszów University of Technology.



S1 Zone - Situated around Rzeszów Jasionka Airport

Area about 70 ha;

- **Industry and high technology services, aviation industry, information technology, chemical, electromechanical industry ;**
- **Infrastructure:**
 - **Road network, natural gas, water network, sewage system (construction started in May 2007 and will be completed till December 2007);**
 - **Electricity network (the construction project is at a final stage of completing);**
 - **Sewage-treatment plant and water purification plant (planned to be completed in July 2007);**
- **Special Economic Zone;**
- **Updated spatial development plan.**

S2 Zone – the zone of Enhanced Business Activity

- **Area about 40 ha;**
- **Less technologically advanced industry, logistic;**
- **Infrastructure:**
 - **Rebuilding of community road is at a final stage of completing (linking S2 from south with road No. 9);**
 - **Creating of infrastructure in progress (project - VIII 2007);**
 - **Total infrastructure will be available in June 2008;**
- **Special Economic Zone – in the zone since 2007;**
- **Updated spatial development plan.**



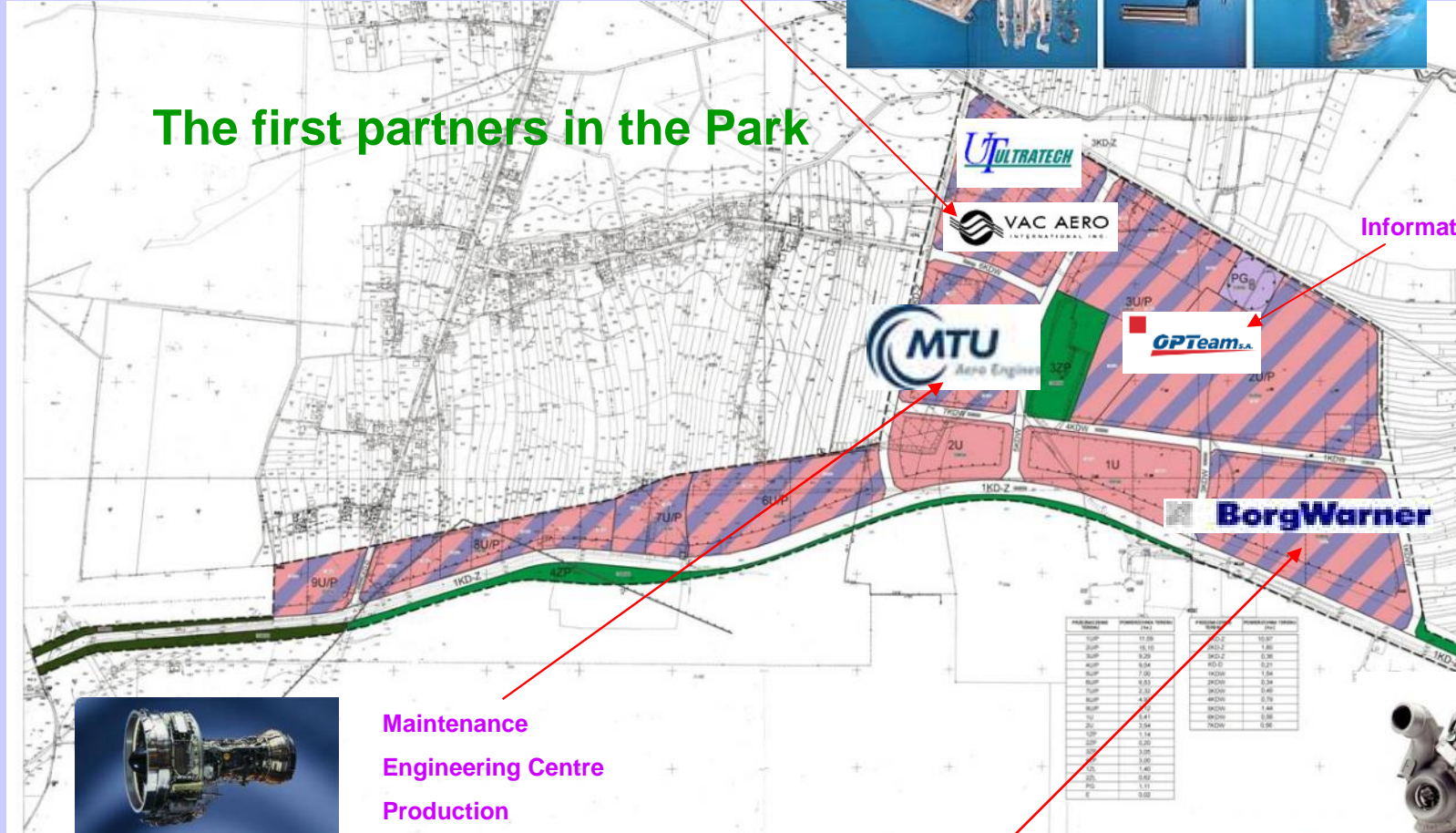
**The Polish Information and
Foreign Investment Agency**

Landing gear parts (Boeing 737 X, CRJ 700)
Door parts (Boeing 757 plane)



- Industry, installations overhaules
- Vacuum brazing
- Nonorganic varnish coatings
- Plasma coatings
- Instruments for aviation

The first partners in the Park



Informatics systems



Maintenance
Engineering Centre
Production



Turbochargers with variable turbine geometries (VTG) for diesel and gasoline engines



Centres of Excellence and Centres of Advanced Technologies

- more than **150 entities** have been qualified as the **Centres of Excellence**
(*within the framework of special awarding procedure executed Ministry of Science and Informatics – now Ministry of Science and Education*),
25 of them are involved in environmental technologies.
- **26 Centres of Advanced Technologies** (Polish acronym: **CZT**) have been established,
half of them area involved in environmental technologies development.

Centre of Advanced Technologies

- **The CZT are interdisciplinary scientific consortia** consisting of scientific entities leading of research and development on top-level as well as from other entities involved in research and development works, and implementation of innovation.
- *The main objectives of these centres are with the aim commercialization of new (mostly national) technologies, products and services in the priority fields of Polish Economy*



The Centre of Advanced Technologies "AERONET - Aviation Valley" was founded in order to realize interdisciplinary, collective and long-term research and training programme as well as effective implementation and commercialization of new technologies aimed at the aerospace industry.



Aeronautica.Integra

The scientific network „Aeronautica Integra” was established to integrate and to increase the activity of Polish scientific groups working in the area of aviation technologies (scientific and industrial partners) within research and education and build sound foundations for transfer of knowledge.



The main goals are:

- to improve the existing manufacturing base,
- to create a strong and reliable network of subcontractors and a low-cost supply chain,
- to attract foreign investment,
- to develop a relationship with other European centres of the aerospace industry,
- to promote joint cooperation of the industry with universities of technology, and research centres.

Centre of Advanced Technologies AERONET Aviation Valley



- Scientific partners
- **Rzeszow University of Technology** – coordinator
- **Czestochowa University of Technology** – partner
- **Lublin University of Technology** – partner
- **Lodz University of Technology** – partner
- **Silesian University of Technology** – partner
- **Warsaw University of Technology** – partner
- **University of Rzeszow** – partner
- **Institute of Aviation** – partner
- **Institute of Fundamental Technological Research Polish Academy of Science** – partner
- **The Szewalski Institute of Fluid-flow Machinery Polish Academy of Sciences** – partner
- **Air Force Institute of Technology** – partner
- Industrial partners
- **Aviation Valley Association (currently 72 companies)** – partner



The Centre of Advanced Technology **AERONET - Aviation Valley** became active in the following main scientific fields pertaining to aviation and related areas:

- Design and testing of aviation structures and propulsions
- Aviation teleinformatics and avionics systems
- Modern materials and surface engineering processes
- Modern production techniques in the aerospace industry

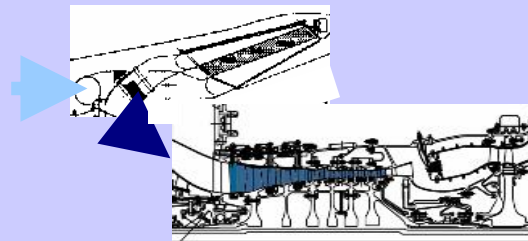
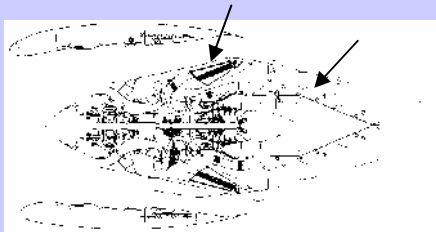


Experience of **Aviation Valley Association companies** of AERONET in realisations of the projects in FP6

Examples



- **ADLAND, STREP, Adaptive Landing Gears for Improved Impact Absorption, PZL Mielec**
- **CESAR, IP, Coste Effective Small Aircraft, PZL Mielec**
- **MagForming, STREP, Magnesium Forming technologies development for the aeronautic industry, ULTRATECH Rzeszow**
- **FILMFREE – novel digital radiography technology, WSK Rzeszow**
- **NEWAC, Nickel Alloy Machining Optimization , WSK Rzeszow**
- **VITAL, New Aero Engine Concepts , WSK Rzeszow**



Aviation Valley Association – industrial cluster – partner CAT

- Local initiative
- Supply chain
- Over 70 Y of tradition
- **72 companies**
- **21 000 employees**
- **Rzeszow University of Technology**
- **Airport**

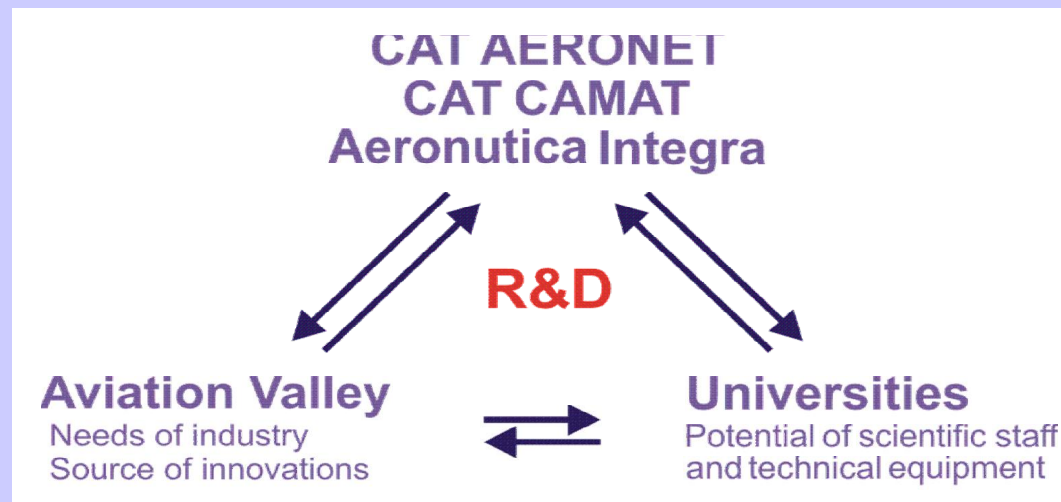




- **Participants:**
- Institute of Non-Ferrous Metals (IMN - Gliwice)
- Stanislaw Staszic Institute for Ferrous Metallurgy (IM - Gliwice)
- Institute of Fundamental Technological Research - Polish Academy of Science (IPPT PAN - Warsaw)
- Aleksander Krupkowski Institute of Metallurgy and Materials Science - Polish Academy of Science (IMIM PAN - Krakow)
- AGH University of Science and Technology, Faculty of Non - Ferrous Metals (AGH-WMN Krakow)
- Warsaw Polytechnic, Faculty of Materials Science (PW - WIM Warsaw)
- **Industrial partners**
- Factory of Transport Equipment PZL Swidnik
- Grupa K ty S.A.

Materials Laboratory in Rzeszow

- This project was realized as a **joint initiative of the Advanced Technology Center “AERONET”** coordinated by Rzeszow University of Technology.



Aeronautics material testing lab – Poland

How Structural Funds can support Research and Innovation

This project is part of the “**Improving the Competitiveness of Enterprises**” objective and receives a total amount of 25.506.000 PLN (€6.7 million), 75% from the ERDF (about €5 million) and 25% from the public funds of the Ministry of Education and Science).

The main aim of the project, finished this year, is **to improve competitiveness and innovation by setting up a modern laboratory for R&D activities in the area of aeronautical material testing.**



AREAS OF RESEARCH WORK

Subject area of scientific research
in R & D Laboratory

Monocrystals
Directional crystallization

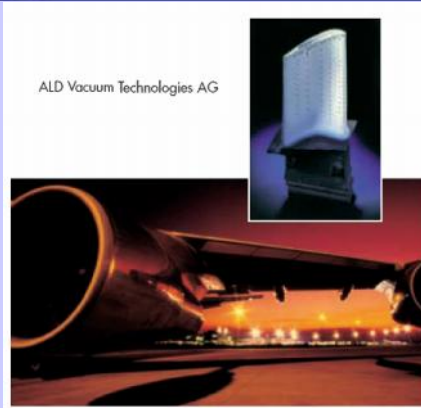
Heat and creep resisting
coatings (CVD)

High speed machining
(HSM)

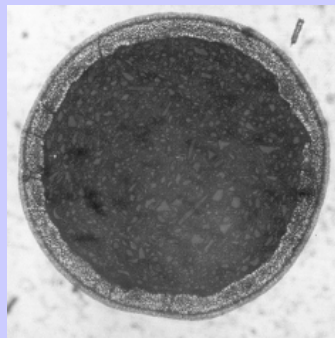
Materials characterization



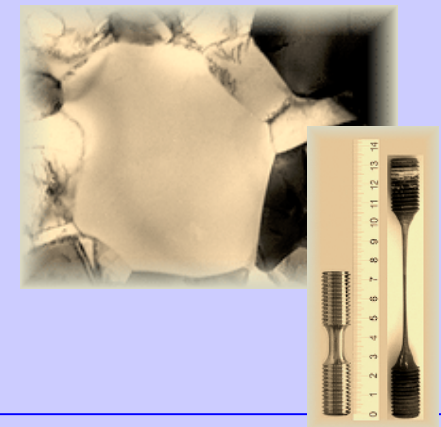
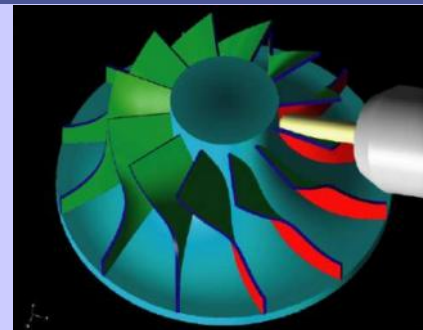
R & D LABORATORY
FOR AEROSPACE MATERIALS



ALD Vacuum Technologies AG



Hot section turbine blade
metallographic cross section of a channel
with 0.5 mm diameter





MONOCRYSTALS / DIRECTIONAL CRYSTALLIZATION

⇒ Laboratory vacuum furnace for directional crystallization of nickel base alloys (*ALD*)

Research and implementation of the technology in the area of directional crystallization and single crystal growing of the nickel base alloys (e.g. turbine blades).

Vacuum in melt chamber min. 10^{-4} Tr;

Melting temperature max. 1700°C;

cooling medium – liquid metal;

cooling plate diameter min. 150 mm;

withdrawal rate: 0.2-300 mm/min;

workspace min. 200x250 mm



TBC coated single-crystal blades



HEAT AND CREEP RESISTING COATINGS

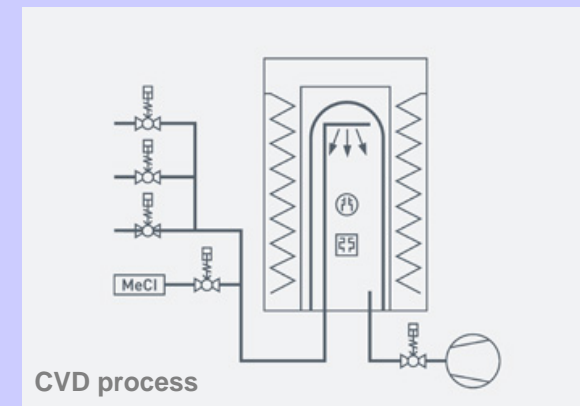
⇒ **Laboratory equipment for CVD coatings deposition (*IonBond*)**

Deposition of thermal barrier coatings on blades and other turbine engine elements. Research work will lead to development of fabrication techniques.

Requirements:

Deposition of coatings containing aluminium, hafnium, zirconium, silicon and chromium with heat treatment possibility.

Workspace **min. 400x800 mm**,
retort diameter **min. 400 mm**,
capacity **min. 150 dm³**.





HIGH SPEED MACHINING

⇒ High speed machining center (*Deckel Maho*)

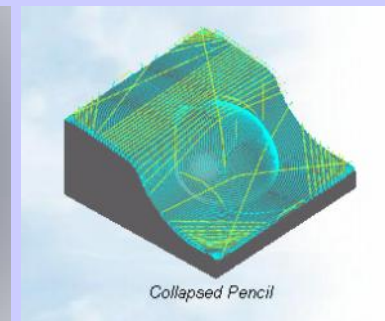
Investigation of the influence of high speed machining on phase composition, microstructure and properties of the surface layer of critical turbine engines elements made of hard machinable materials.

Max. working speed: **36000 rev/min**

Max. rate of feed: **40 m/min**

Numerical control

Workspace **min. 500x500x500 mm**

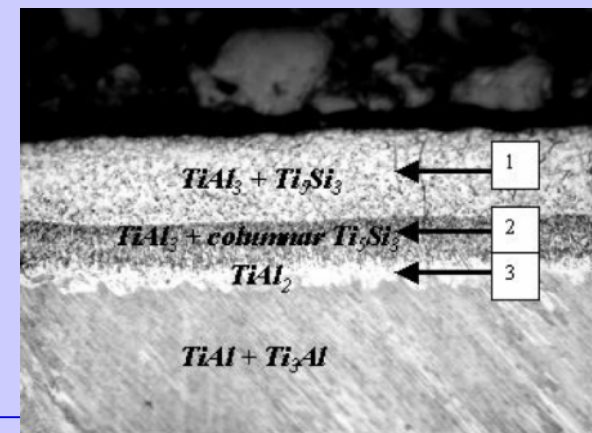




MATERIALS CHARACTERIZATION (1)

⇒ MICROSTRUCTURE EXAMINATION

- METALLOGRAPHIC AND STEREOSCOPIC LIGHT MICROSCOPES (Nikon, Zeiss)
- TRANSMISSION ELECTRON MICROSCOPE (WITH EDS) (Jeol)
- SCANNING ELECTRON MICROSCOPE (WITH EDS, WDS) (Hitachi, Novascan)
- EQUIPMENT FOR PREPARATION OF THIN FOILS AND REPLICAS (Balzers, Jeol, Gatan)
- EQUIPMENT FOR PREPARATION OF METALLOGRAPHIC SPECIMENS (Struers)





MATERIALS CHARACTERIZATION (2)

⇒ **PHASE TRANSFORMATIONS AND AND PHASE COMPOSITION ANALYSIS**

- **THERMAL ANALYZER (DTA, DSC, TMA) (*Setaram*)**
- **X-RAY DIFFRACTOMETER WITH HIGH-TEMPERATURE CHAMBER (ARL XTR 'a)**
- **DILATOMETER WITH SAMPLE DEFORMATION CAPABILITY (B ähr)**



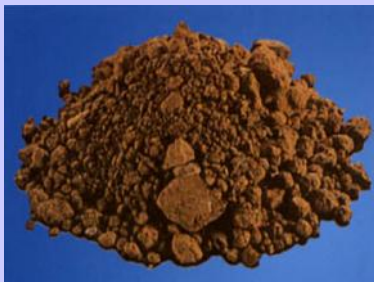
MATERIALS CHARACTERIZATION (3)

⇒ **ANALYSIS OF CHEMICAL COMPOSITION**

SPECTROMETERS WITH STANDARDS SET:

GDS and ICP (*Jobin Yvon*), XRF and spark (*ARL 3460*)

GAS ANALYSER (*Leco*), DIFFRACTOMETER (RTG) ARL





MATERIALS CHARACTERIZATION (4)

⇒ TESTING OF MECHANICAL PROPERTIES

- **DUAL-STATION CREEP-TESTING MACHINES (Walter Bai AG)**
- **FATIGUE TESTING PULSATOR (LDS)**
- **HARDNESS TESTERS (Zwick, Struers, Instron)**
- **IMPACT TESTER (Zwick)**
- **WEAR RESISTANCE TESTING DEVICE**
- **HYDRAULIC TESTING MACHINE INSTRON**
- **MECHANICAL TESTING MACHINE UTS**



MATERIALS CHARACTERIZATION (5)

⇒ **HEAT TREATMENT, THERMODYNAMICS OF THE ALLOYS**

ELECTRIC MELT FURNACE (*Balzers*)

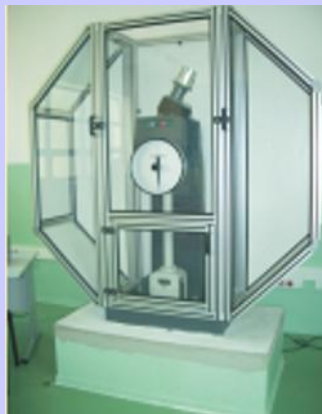
DIGITAL TEMPERATURE RECORDERS (*Hioki*)

⇒ **NONDESTRUCTIVE TESTING**

ULTRASONIC FLAW DETECTOR (*Krautkrämer*)

Main Equipment:

- Gas analyser
- Glow discharge spectroscope (GDS)
- X-ray fluorescence spectroscope (XRF)
- Optical emission spectrometer ICP
- Scanning electron microscope (SEM) with EDS
- Transmission electron microscope (TEM)
- Deformation dilatometer
- Dual-station creep-testing machines - 2 units
- Laboratory furnace for heat treatment
- Digital temperature recorders
- Ultrasonic defectoscope
- Devices for sample preparation
- Standards and elements for spectroscopy
- Mechanical testing machine UTS
- Diffractometer (Rtg) ARL
- Spectrometer (sparc) ARL 3460
- Vacuum furnace BALTZERS

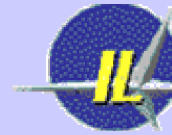


- Vacuum furnace for directional crystallization
- Equipment for generating of CVD coatings
- High speed machining center (HSM)
- Pulsator for fatigue tests
- Hardness tester
- Temperature scanner
- Balancer for rotational tools
- Light microscope equipped with digital image analyser
- Stereoscopic microscope
- Vibration measurement system OUPN
- Impact tester
- Ion milling device
- Calorimeter SETARAM
- Hydraulic testing machine INSTRON

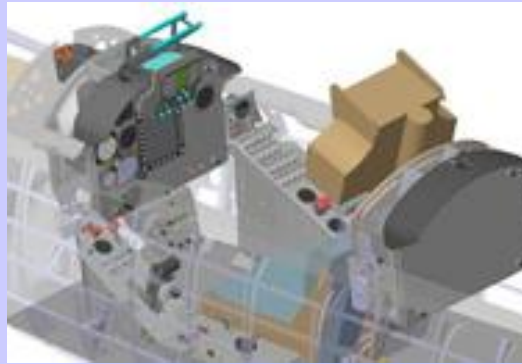
SELECTED EXAMPLES

**related to research work dealing with
equipment**

Adaptive Landing Gears



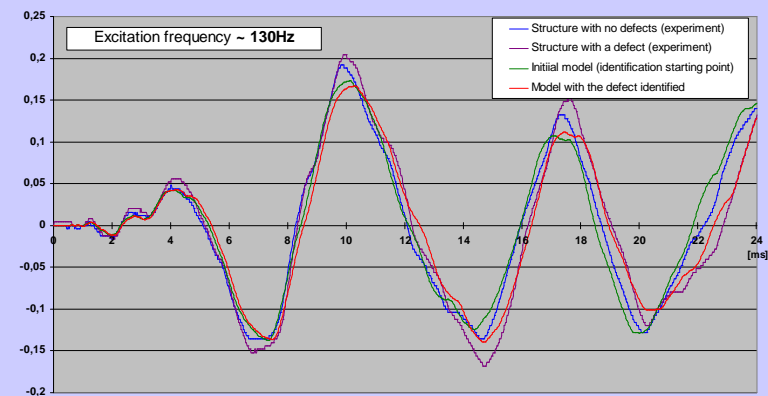
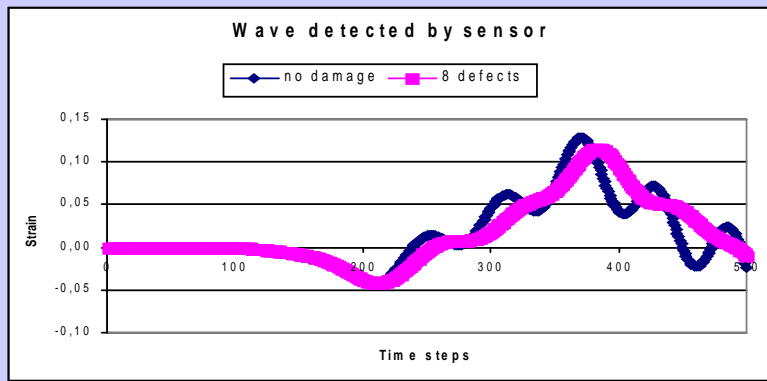
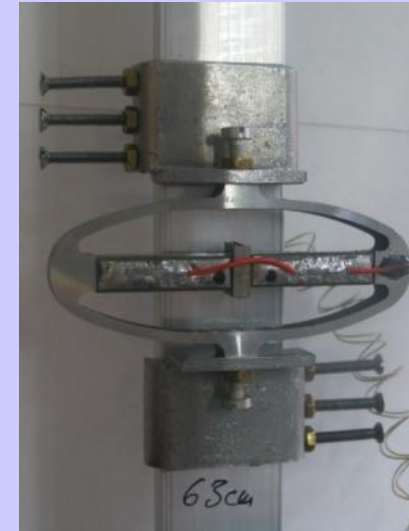
Avionics and Aero-engines



Structural Health Monitoring



- PIEZODIAGNOSTICS
- SAFE PIPES





- control systems theory,
- flight control systems,
- digital control systems,
- onboard data recording systems.



Flight control systems:

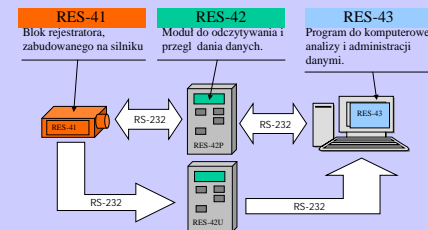
- Digital autopilot for executive and commuter aircraft,
- Navigation and control systems for unmanned aircraft,
- Indirect flight control system (Fly-by-wire) for general aviation aircraft.

Low cost on-board equipment:

- Flight data recorders,
- Strap-down attitude and heading reference systems,
- Air data computers,
- Electromechanical actuators with digital controllers.



- On-board digital equipment – hardware and software design and prototyping, hardware-in-the-loop simulation,
- Flight control systems – design, building and testing,
- Flight tests – measuring, recording and data processing,
- Handling Qualities analysis, flight simulation experiments and analytical evaluation of pilots' skills,
- Control theory and practice – including fuzzy logic and rough sets.



GA equipment: Simplified and intuitive flight controls, envelope limiting, active load control:

Indirect Flight Control System

- More sophisticated experiments using the modified flight simulator Alsim AL-200 MCC
- Application of indirect flight control system on the board of twin-engine EM-11 Orka aircraft (Polish GA airplane)



**Facilitated
Airplane (FA)
or Safe Flying
Airplane (SFA)**





Reasons for international collaboration

- Possibilities of conducting European-scale research
- Long tradition of polish aerospace industry
- Cooperation between science and industry

