



**National Aerospace University "KhAI"**

# **KhAI Capabilities in aeronautic research**

**Kharkiv, Ukraine**

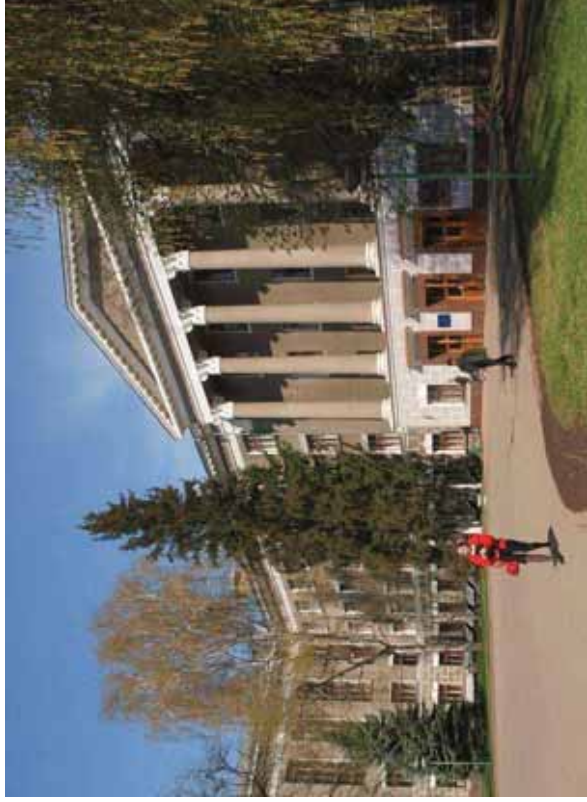
**Lina Smovziuk**

**International S&T Projects manager**

# Who we are:

## National Aerospace University «KhAI»

- 1930 - Founded as **Kh**arkiv **A**viation **I**nstitute
- 1998 - Aerospace University
- 2000 - National Aerospace University



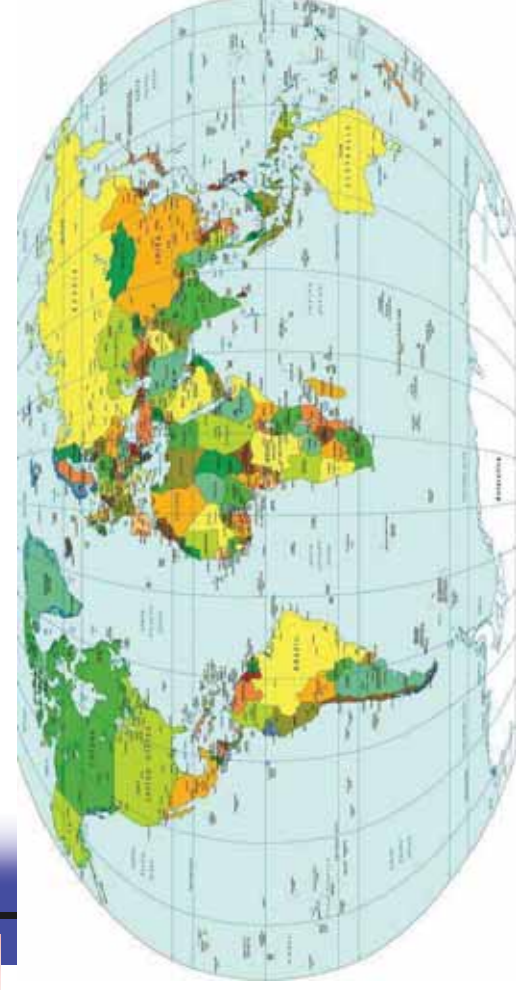
# Today

## National Aerospace University «KhAI»

- 12000 students
- 160 postgraduates
- 700 teachers (400 Ph.D., 95 D.Sc.)
- 2000 employees
- 10 Schools
- 27 Specialities
- 45 departments
- terr. 25 hectares



# International Activity:



More than 1000 students  
from 60 countries

EASN associate member

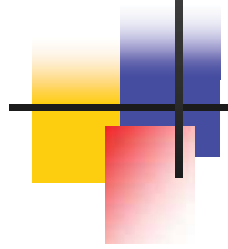
PEGASUS associate  
partner

## Research Collaboration:

- United States
- United Kingdom
- Germany
- France
- Finland
- Mexico
- South Korea
- China
- Austria
- Sweden
- Australia



# OUR PARTNERS



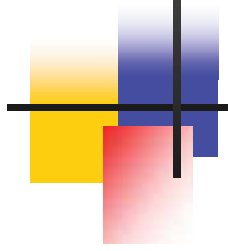
**AIRBUS**  
AN EADS COMPANY



**BOMBARDIER** **PIAGGIO AERO**



Institut Supérieur de l'Aéronautique et de l'Espace



# EU Research Projects:

- **FP6 -- SENARIO** (Advanced Sensors and Novel Concepts for Intelligent and Reliable Processing in Bonded Repairs)
- **FP6 -- ALCAS** (Advanced Low Cost Aircraft Structures)
- **FP7 - HPH.com** (Helicon Plasma Hydrazine Combined Micro Engine)
- **FP7 -- AERO-UKRAINE** (Support actions for further cooperation EU/Ukraine aeronautic communities)
- **FP7 -- WASIS** (Composite Fuselage Section Wafer-design Approach for Safety Increasing in Worst-case Situations and Minimizing of Joints)



## EU TEMPUS projects:

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- Tempus JEP 26212-2005 "Promoting Excellence in Aerospace Engineering" (2006-2008)
- Tempus JEP 26008-2005 "MSc and PhD Studies in Aerospace Critical Computing" (2006-2009)
- Tempus JEP 27201-2006 "Introducing EU-compatible MSc degree in Engines and Aircraft Power Systems" (2007-2009)
- Tempus JEP 27300-2006 "Logistics for aviation engineering: Curriculum and Training Center"



# What we do?

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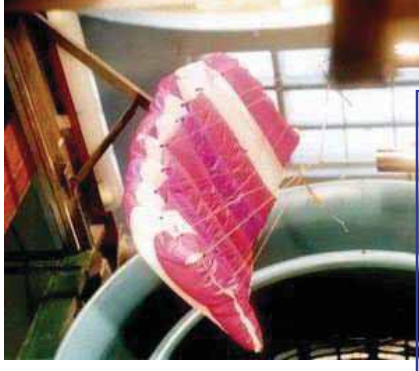
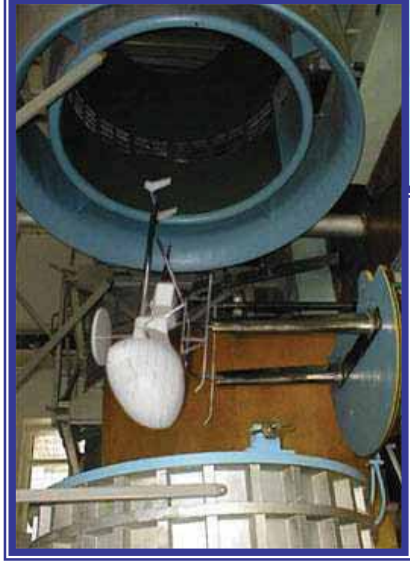
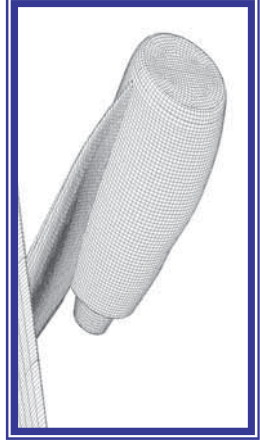
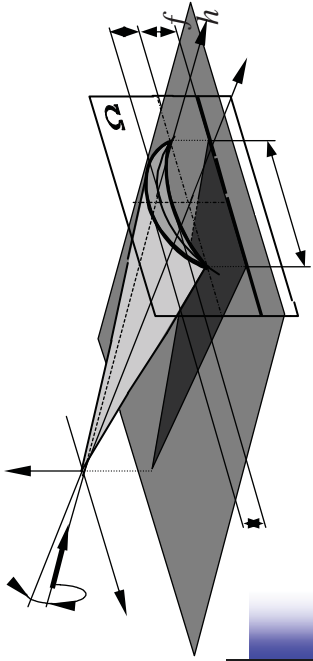
# Subsonic and supersonic aerodynamics.



Unique aerodynamic complex consisting of six wind tunnels, including the supersonic one with the Mach number of 1 to 4

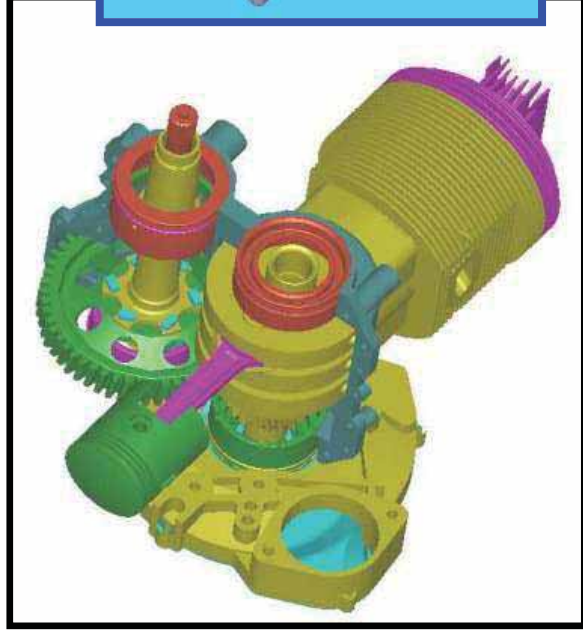
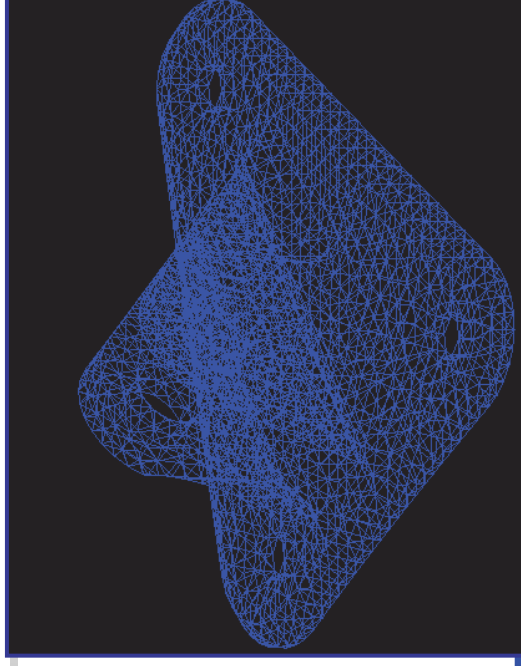


# Aerodynamic Simulation and Wind tunnel tests



# Design Center CAD/CAM/CAE

UNIGRAPHX, EUCLID, ANSYS,  
NASTRAN, COSMOS, SOLID  
WORKS, LS DYNA etc.  
Design, 3D models, FEM



# Family/business auto-gyro

- Vertical takeoff/landing
- Max weight – 840 kg
- Crew – 4
- Max speed – 245 km/h
- Range – 800 km





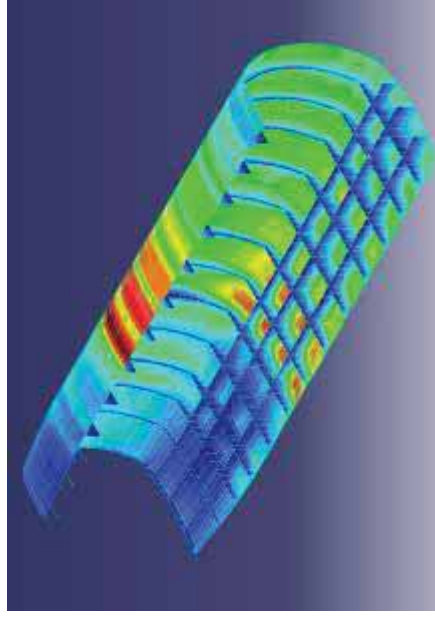
# Structural strength:

## Static and fatigue test facilities

- Aircraft structures full-scale testing
- Static and fatigue materials characterisation
- Structures fatigue life-time prediction

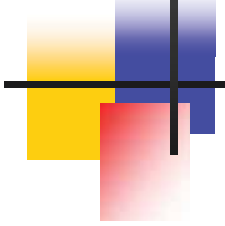
### Certified:

- Aviation Regulations of Ukraine, part 23, sections C and D.
- Airworthiness Specifications JAR-VLA, sections C and D.





# Unmanned Aerial Vehicles (UAV)



# UAV Civil Application Projects

(1-st Ukrainian Innovation Competition Winner)



## INSPECTOR

Oil/gas pipelines monitoring

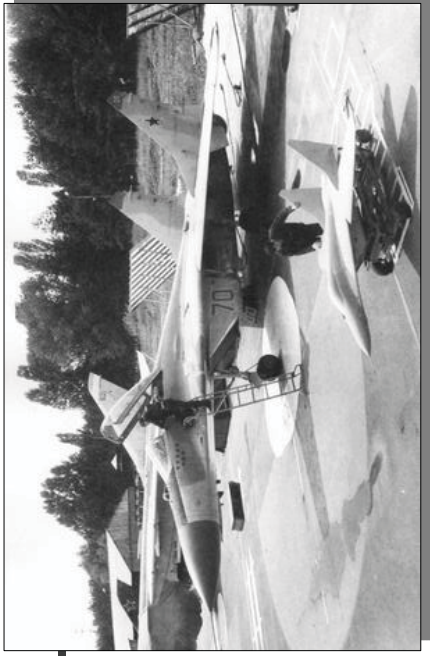
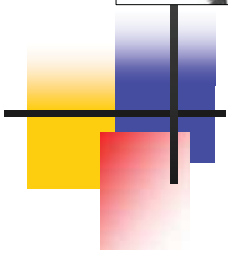


## GyroBee

### Precision agriculture:

- crops monitoring
- chemical treatment

# Supercritical Flight Tests with Free-flying models



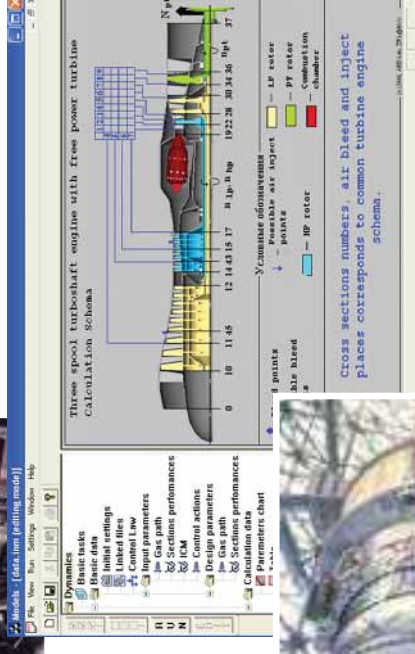


# Aircraft engine research

Simulation and testing of gas-dynamic processes in gas-turbine engines. Joint projects with KIMM (Korea)

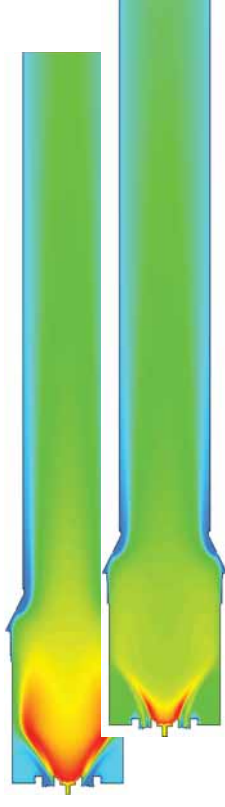
Real-time diagnostics of gas-turbine engines. Commercial application by CCC (USA).

Engine control simulation software

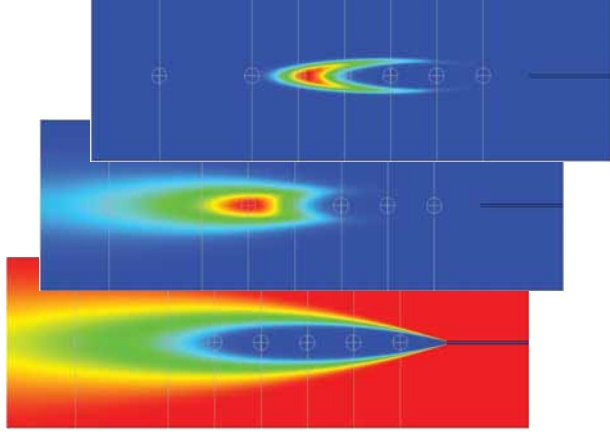
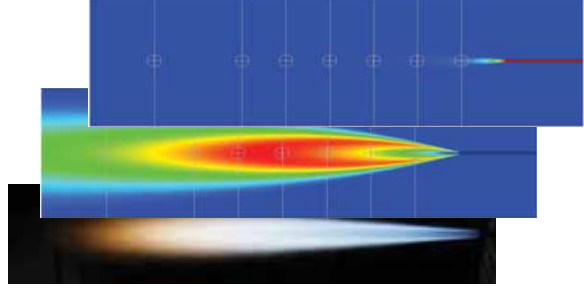


# Green engine: emissions decreasing

- **alternative fuels  
(hydrogen, biofuels  
and synthetic fuels)**



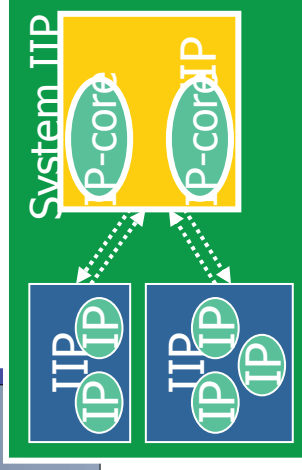
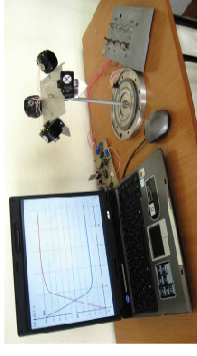
- **engine exhaust  
composition modeling  
tools development**



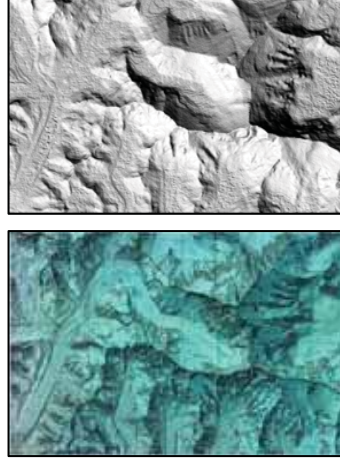
- **combustor innovative  
design for further  
NOx reduction.**



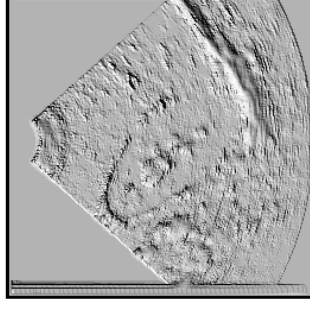
# Control Systems:



- UAV Auto-pilot system

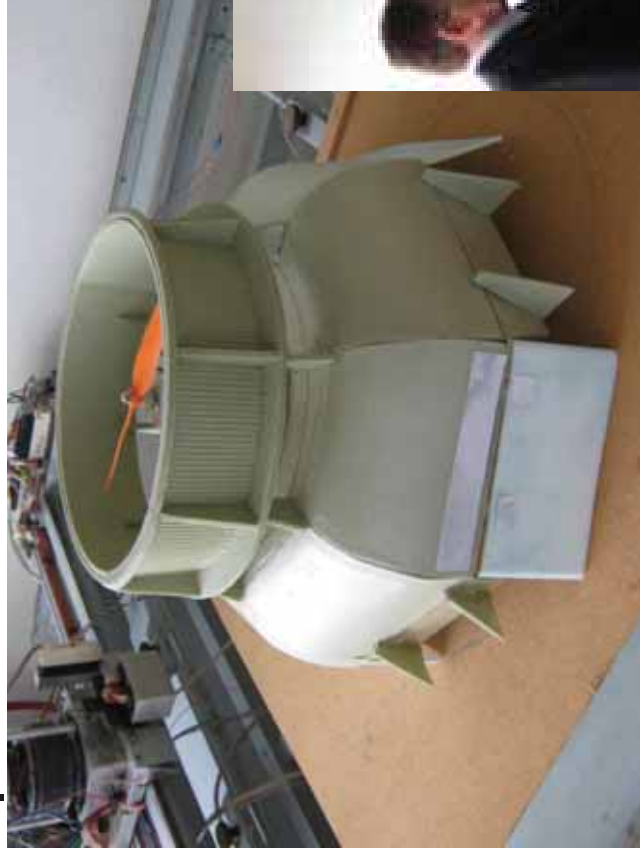


- Fault-tolerant embedded control systems



- Remote sensing & advanced signal processing

# Control systems for “non-standard” aircrafts



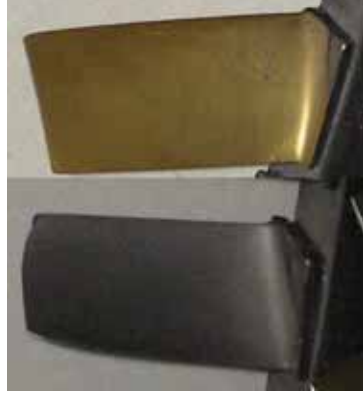
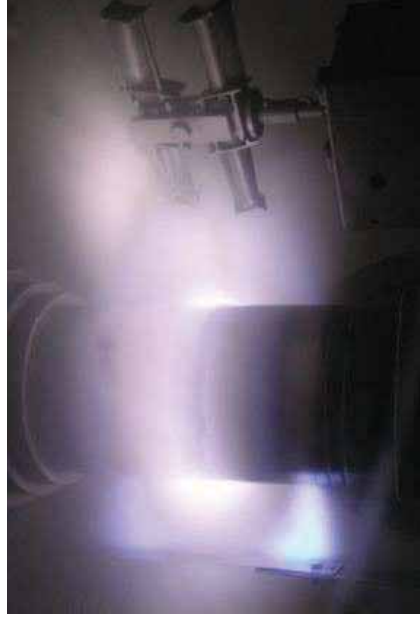
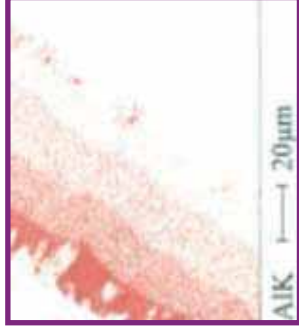
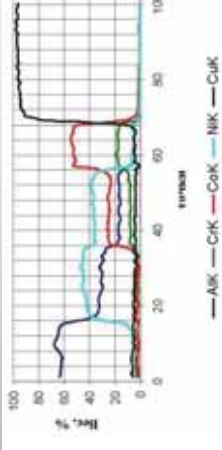
“Coanda effect”-  
based vehicle



Flight test

# Coating technology

## Multi-layer nano-scaled coatings



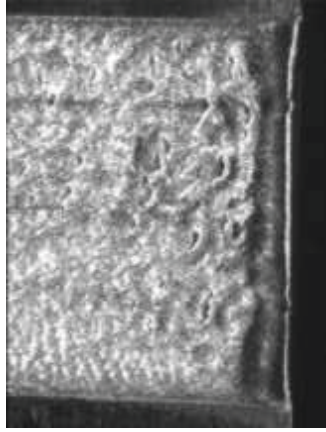
- Erosion-resistant
- TBC
- Photo chromic
- Hardening

# Metal-nanodiamond electroplating coating

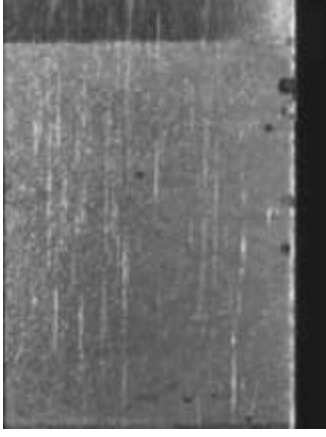
(Joint research with SINTA Ltd., Ukraine and DKI, Germany)



- Sufficient (3-8 times) parts lifetime increasing = operational cost decreasing
- Lower coating thickness = sufficient Cr economy = manufacturing cost decreasing
- Plating line productivity increasing = manufacturing cost/time decreasing
- Lower Cr consumption = environmental benefits

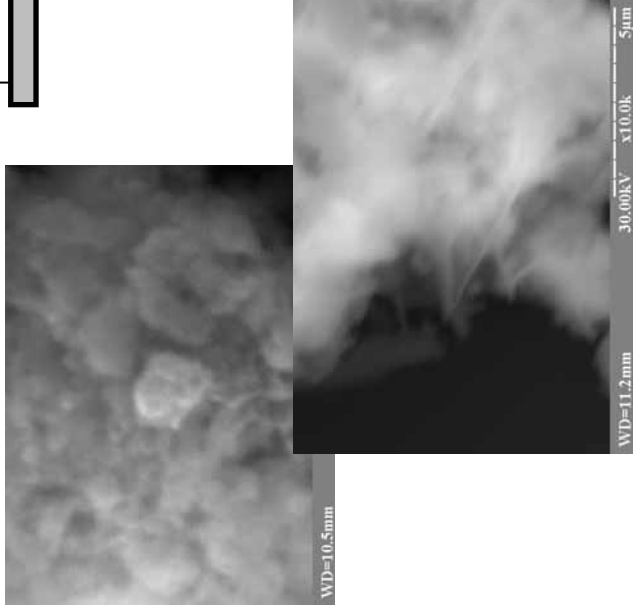
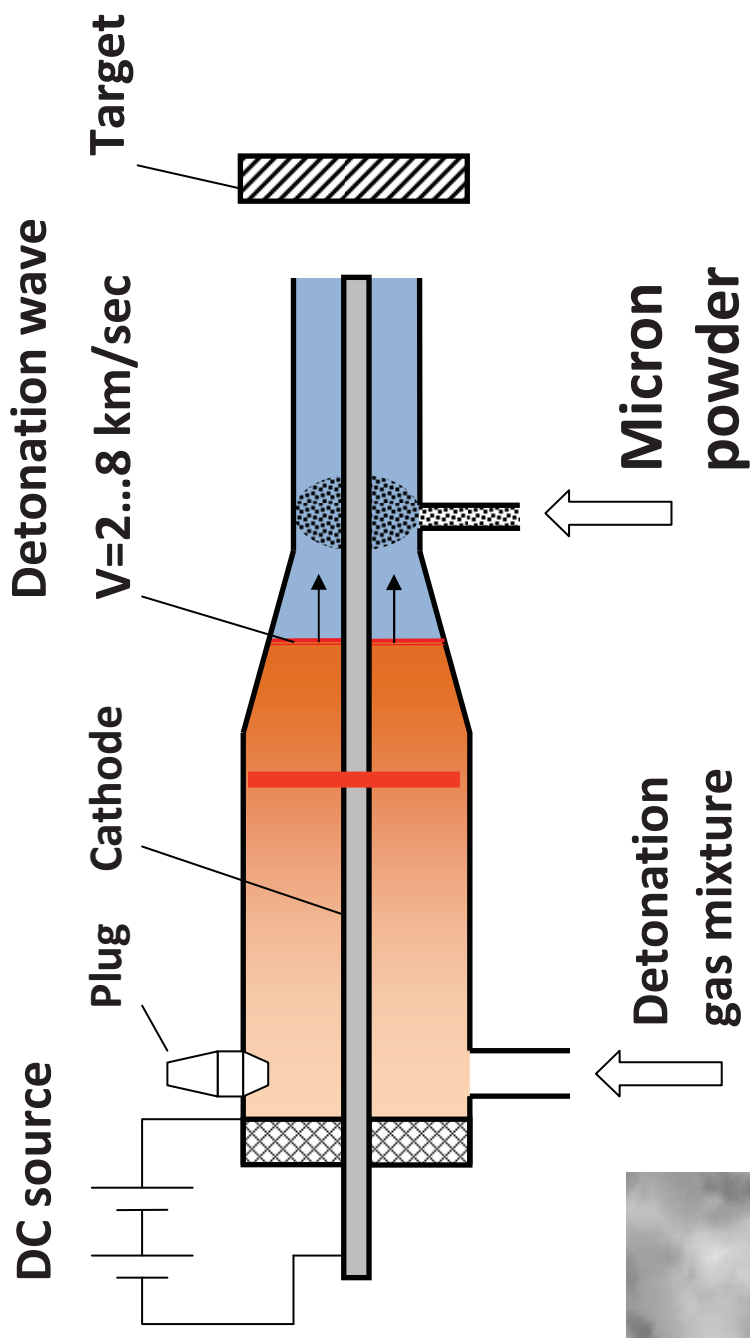
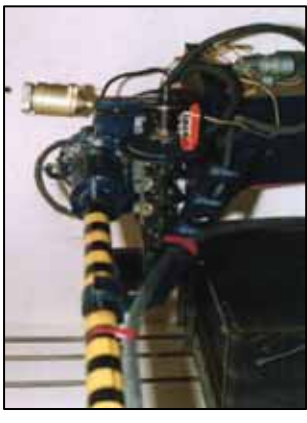


Plastic injection feed screw



# Nano-powders gas-detonation manufacturing technology

(Presented at TechConnect 2009, Houston)

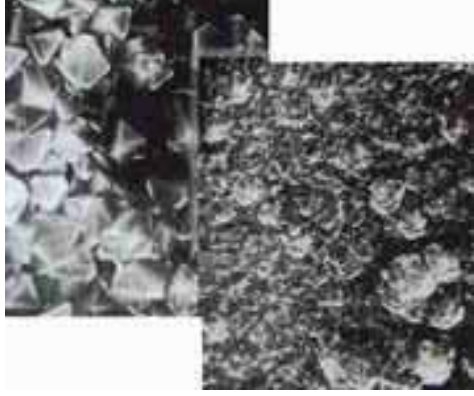
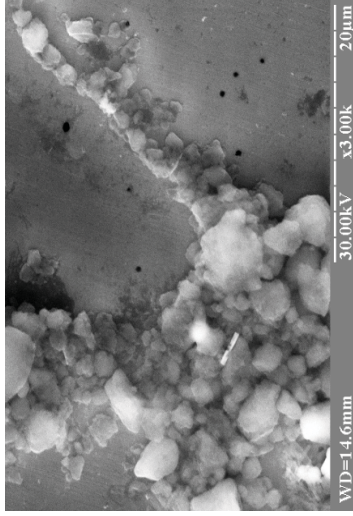




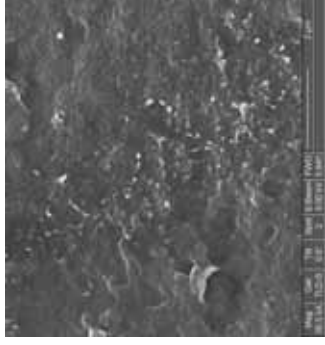
# Epoxy resin and CRP mechanical properties enhancement with UNCD

(Joint research with SINTA Ltd., Ukraine)

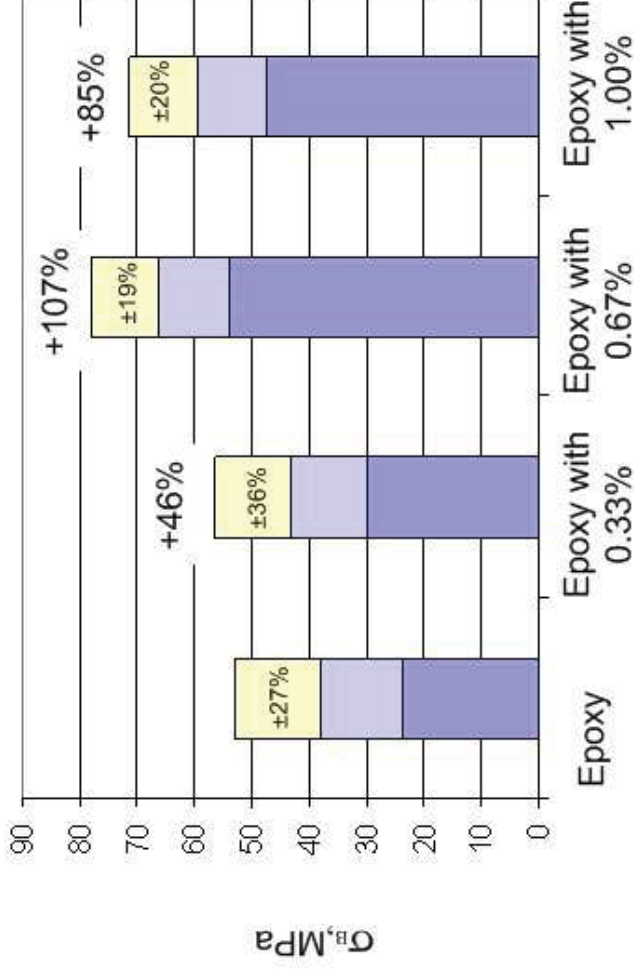
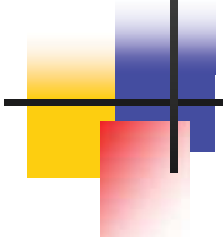
## Ultra-NanoCrystalline Diamonds, UNCD



Crystal Size	4 – 8 nm
Aggregate size	20 – 50 nm
Specific Surface	300 m <sup>2</sup> /g
Density	3.1 – 3.2 g/cm <sup>3</sup>
Bulk Weight	0.4 – 0.6 g/cm <sup>3</sup>
Lattice Constant	0.3573 nm



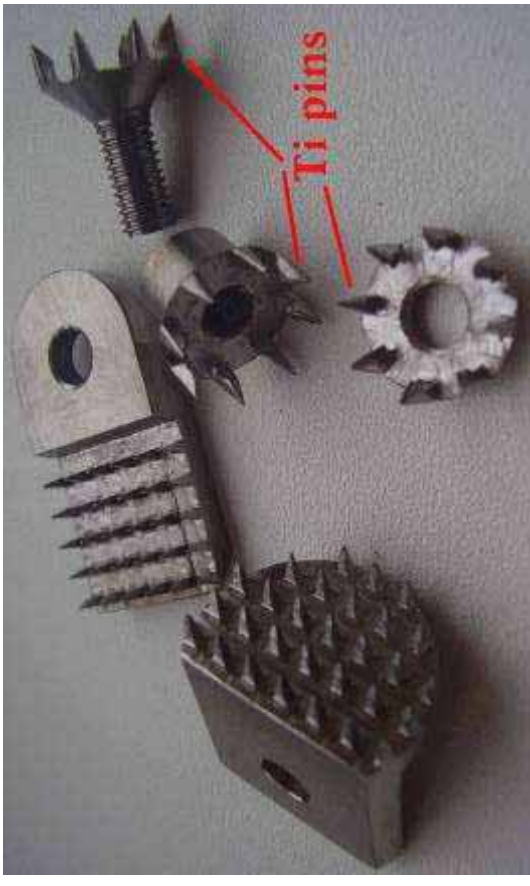
# UNCD-Epoxy test:



UNCD-Epoxy Tension Breaking Point, MPa

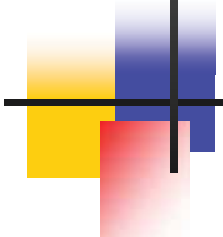
**(107% increasing)**

# Heterogeneous Composite-to-Composite and Composite-to-Metal heavy-loaded joints (STCU P296 project with EOARD)

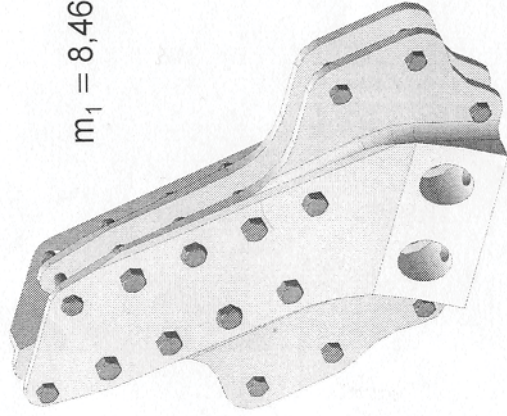


**Key technology of FP7 WASIS project**

# Practical Results:

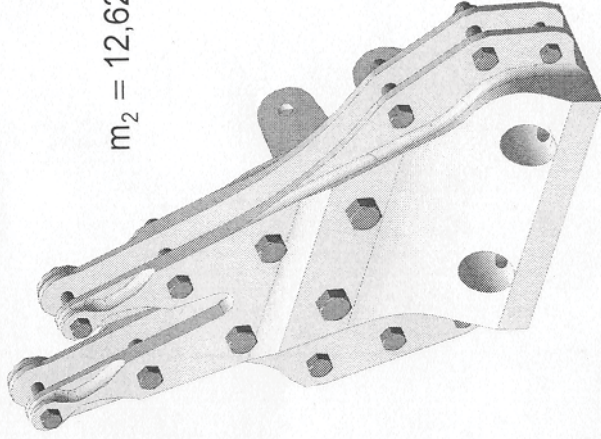


$m_1 = 8,46 \text{ kg}$



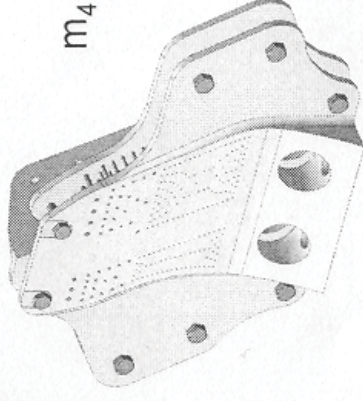
Existing cargo  
aircraft fin  
fitting

$m_2 = 12,62 \text{ kg}$



Manufacturer's  
re-design

$m_4 = 5,65 \text{ kg}$



Re-design using  
micro-fasteners

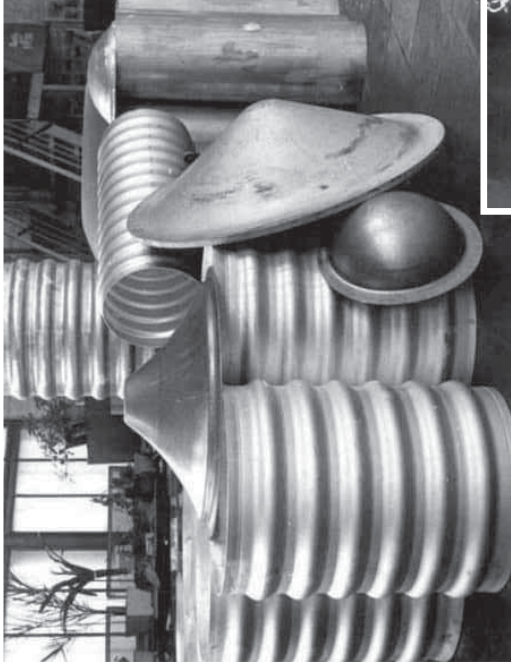
**Weight  
saving  
33%**



# High-speed forming and cutting technology: explosive, electro-hydraulic

(STCU P326 project with DoE, Ford, and PNNL)

- Aviation engines parts of complex 3D geometry
- Large dimensions ship parts
- Automotive parts of advanced alloys
- Continuous casting metal cutting

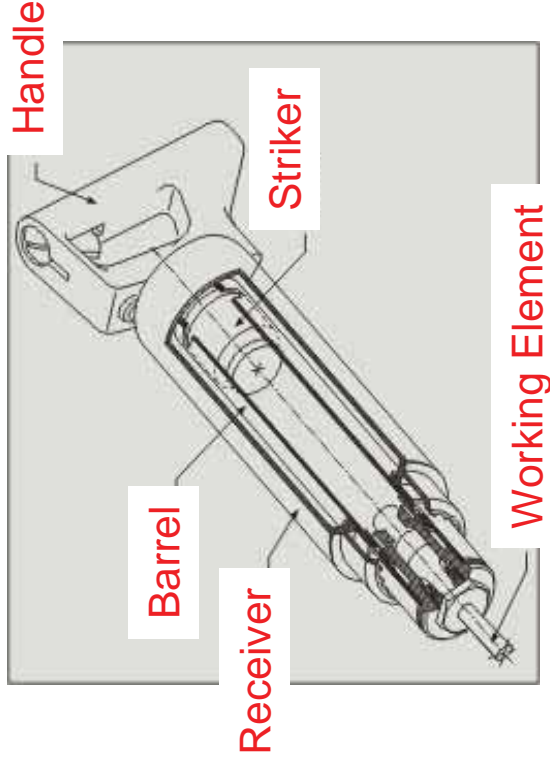


**US Pat.  
4,020,663  
3,518,860**



# Composite Laminates Single-Impact Riveting Technology

(STCU P245 project with Boeing)

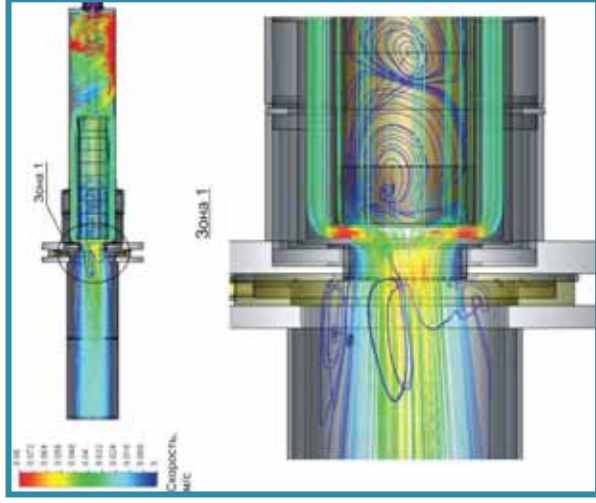
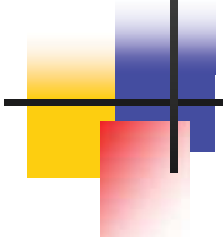


1. Compressed air energy accumulated in the receiver
2. Energy released
3. Striker is accelerated in the barrel
4. Striker hits working element
5. Working element = rivet die



MPI-90M Riveting Hammer

# Heavy-duty industrial plasma torches



**Plasma torch  
gas-dynamic  
processes  
improved**



**Engineering model**



**Prototype testbed**



**Cathode vacuum test**



## We are seeking partnership for:

- FP7 Aeronautics Call participation (but not limited to!)
- Two-way exchange of ideas and demand
- Strategic partnership
- Joint R&D projects
- Patenting and licensing
- Commercialization
- Spin-off and joint ventures



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