Advanced Coatings

Introduction

Advanced Coatings (AC) part of the Research Group 1-06 is focusing on processing, research and development of high performance coatings for aerospace, automotive, power energetics and biological/biomedical applications. As an example the high temperature coatings, the cavitation resistant coatings and the wear resistant coatings produced by means of air spraying, thermal spraying or electro-chemical methods can be mentioned. The members of the research group coming from materials science and engineering, physics, chemistry and computational science branches also focus on research, development and failure analyses of bulk metallic alloys, surface and interface interactions, and powder processing in close collaboration with Industry. AC is as well responsible for development of uncommon and unconventional testing techniques like cavitation resistance testing apparatus, cyclic furnace oxidation test, jet corrosion-resistant test, etc.

General areas of AC part of Research Group interest

- Coatings for aerospace and automotive high temperature applications (diffusion coatings, overlay coatings, thermal barrier coatings)
- Cavitation resistant coatings and wear resistant coatings for power energetics
- Functional and/or decorative electro-chemical coatings
- Coatings for biological/biomedical applications
- Bulk metallic alloys surface interaction studies
- Powder processing techniques
- Development of unique or uncommon testing techniques

Most of above mentioned activities running under the projects supported by:

- Czech Science Foundation:
  - Plasma deposition, microstructure and thermomechanical stability of environmental barrier coatings
- Ministry of Industry and Trade:
  - Research and development of processing technology of non-toxic small caliber bullets
  - Research and development of roller bearing of mixer truck gearbox
- Technology Agency of the Czech Republic:
  - Research center of surface treatments
  - Research and development of high-speed surface machining technology for hard-surface coatings manufactured by means of thermal spraying
  - Research of advanced non-ferrous lightweight alloys for engineering applications

R&D active areas of AC part of Research Group:

- Thermal spraying (flame spray – powder / wire, twin wire arc spray, atmospheric plasma spray, high velocity oxyfuel spray, apparatus for vacuum and low pressure plasma spray is under the construction)

- Coatings for high temperature materials (diffusion coatings, overlay coatings, thermal barrier coatings)
- High and low temperature processing of HA, CDHA, a-TCP and b-TCP coatings for biological/biomedical application
- Spraying and surface finishing of hard ceramic or cermet coatings
- High temperature materials (nickel, cobalt and molybdenum-based superalloys)
- Formation of nickel-based aluminides and iron-based aluminides (intermetallics)
- Modification of aluminum alloys via surface treatments and additional heat treatment (Al, AlSi9Cu3, AlMg3, etc. – element interaction studies, interfaces, diffusion)
- Non-ferrous alloys (aluminum, magnesium and zinc)

Planned activities:

- More detailed studies on thermal barrier coatings, CMAS resistant coatings, cavitation resistant coatings, hydrophobic coatings, abrasive and wear resistant coatings produced by the means of solid and/or liquid feedstock
- More detailed studies on hydro machine close circuits or stands for magnetically conductive ultrafine powder production
- More detailed studies on biodegradable bulk metallic materials
- More detailed studies on low temperature electro-chemical processing of coatings, decorative and/or hard anodizing

Currently we are constructing/finishing the following apparatuses:

- Jet test – 3/2015
- Rubber wheel test (solid powders/abrasive solutions) – 6/2015
- Slurry abrasion test – 6/2015
- FOD impingement test (with sample heating up to the 1300°C) – 6/2015

Laboratories:

a) Separate CEITEC Lab on Spray Technologies (build and work in close collaboration with S.A.M.-metallizing company)

Blasting Units

- OTECO set-up from 1 to 6 atm.

APS system

- Plasma GTV MF-P-1000
- gun METCO F4MB-XL
- powder feeder GTV MF-PF-2/2

HVOF system

- GLC HVOF 05
- gun HVOF GLC

TWAS system

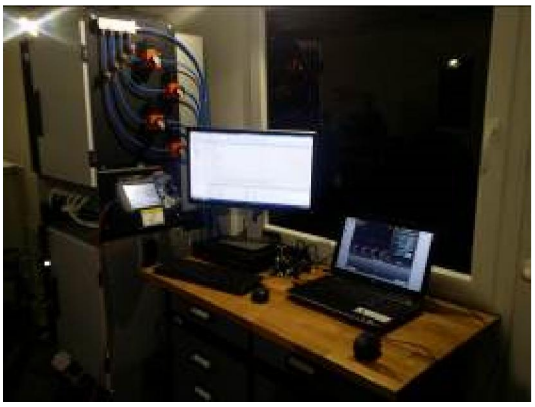
- Oerlikon Metco 4R

Flame system (CMAS deposition)

- Powder / Wire – Oerlikon Metco

Thermal spray monitoring unit

- TECNAR Accuraspray G3C unit (to control and set-up thermal spray parameters)



Robot

- ABB IRB 2600 + IRC5 controller

Liquid solution / paints air spray

- Automatic air guns EST+
- Automatic pre-set up pressure tanks

Powder and liquids processing

- Semi-Micro analytical balances DISCOVERY DV314C
- Mechanical overhead stirrer HEIDOLPH RZR 2021
- Magnetic stirrer HEIDOLPH MR Hei-standard
- Ultrasonic homogenization bar SONOPLUS HD 3400
- Sieve shaker AS 200 digit

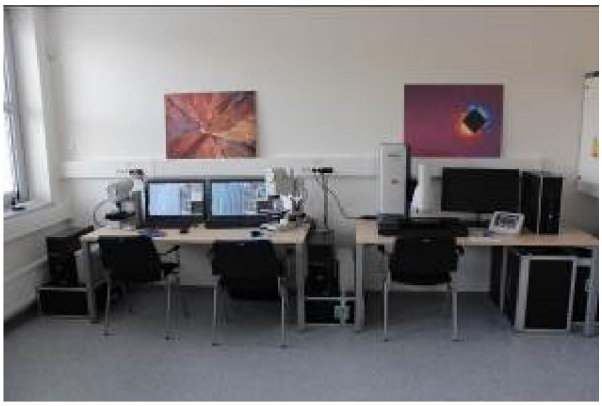
Testing

- Porosity - Archimedes method, in RG internal collaboration BET adsorption analysis, mercury intrusion porosimetry
- Ultrasonic testing according to ASTM standards

b) Heat treatment and Chemistry Lab

- Furnaces up to 1350°C
- Programmable atypical two zone heated furnace for cyclic oxidation tests (heated zones: 1200 °C / 900 °C / other zones: Air forced cooling / Ambient cooling)
- Chemist laboratory and equipment
- Analytical microbalances
- Control climate chamber (in internal RG collaboration)

c) Materials Science Lab



- Metallography (STRUERS cutting machines, presses, grinding/polishing units)
- Microscopes (OLYMPUS opto-digital microscope DSX 500i, in RG internal collaboration TESCAN MIRA scanning electron microscopes, LYRA focused ion beam and FEI TITAN High resolution transmission electron microscope (HR TEM will be installed 10/2015)
- Phase analyses (in RG internal collaboration powder and planar X-ray diffractometers RIGAKU SmartLab)

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