

Short Term Scientific Mission Report

Bratislava, Slovakia, 6. – 18.12.2004.

Host Institution:

Institute of materials & machine mechanics,
Slovak academy of sciences
Bratislava, Slovakia
Dr. ing. František Simančík

Candidate:

Ivan Kramer
University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
Department of Materials
Zagreb, Croatia

COST Action and working group

COST 532 - "Triboscience and Tribotechnology"
WG – Transmission systems (Project TS 8)

Goals of the STSM

The purpose of this visit was an expert and research study of following areas:

- plasma sprayed coatings
 - large cylinder coated with Al_2O_3
 - small pieces coated with ZrO_2 + hidroxyapatite
- gas sprayed coatings (ceramic coatings (oxide and carbide), metallic coatings and polymer coatings)
- PVD, CVD coatings
 - coating of W or C fibers with ceramic materials
- measuring properties of thermally sprayed coatings: nanohardness, coating – substrate properties, mechanical properties etc.
- production of aluminium foam components
- production of metal matrix components
- testing of intermetallics properties

Description of the visit

- 06.12.2004.** Arrival in Bratislava.
Meeting with Dr.ing. František Simančík, Dr.ing. Jaroslav Jerz, Dr.ing. Juraj Korab and Roman Florek Ph.D.
Discussion was about following subjects:
- my research work and area of interest
 - possibilities and equipment of IMMM SAS laboratories
 - my working schedule within this Short Term Scientific Mission
- 07.12.2004.** IMMM SAS Thermal Spraying Laboratory
Plasma coating of cylinder with dimensions $\phi 200 \times 350$ mm. Preparation of

cylinder (sand blasting), determination of coating parameters (power, speed of the gun, etc.) and coating with METCO Al₂O₃ ceramic powder. This cylinder is used as a part of machine in textile industry.

- 08.12.2004.** IMMM SAS Thermal Spraying Laboratory
Plasma coating of small cylindrical samples made from titanium alloys. Preparation of samples and coating with hydroxylapatite and ZrO₂. These parts are used as dental implants.
- 09.12.2004.** IMMM SAS Thermal Spraying Laboratory
Gas (oxygen, acetilen) spraying of aluminium alloy plates. Equipment for thermal spraying is UTP UNI – Sprayjet. Preparation of plates (sand blasting) and coating with Ni₃Al Amdry powder. This plates (50 x 300 mm) are used for manufacturing sandwich lightweight plates.
- 10.12.2004.** IMMM SAS
CVD coating of fibers.
W or C fibers were coated with ceramic materials (SiC). This type of coated materials are used as reinforcement in metal matrix composites.
- 11.12.2004.** Weekend
Analysis of results.
- 12.12.2004.** Weekend
Analysis of results.
- 13.12.2004.** IMMM SAS Racianska
Determination of properties of thermally sprayed coatings (Al₂O₃ on steel cylinder, ZrO₂ + hydroxylapatite on titanium alloy sample, Ni₃Al on aluminium alloy plate). Measuring of strenght and adhesion of plasma sprayed coatings, microhardness testing, fracture properties of layers, plastic and elastic properties, etc.
- 14.12.2004.** IMMM SAS Racianska
Structural analysis techniques: electrom microscopy (SEM, TEM), X – ray analysis, mass spectroscopy, diffraction DTA, EDX – microanalysis, surface tension.
- 15.12.2004.** IMMM SAS Patronka
Production of aluminium foam components from compacted precursor. Making of aluminium foam blocks (55 x 35 x 240 mm) with and without reinforcement (stainless steel mesh) and aluminium foam sphere (ϕ100 mm). Parts were produced in mould kept in furnace (temperature ~800°C, time 10 – 15 minutes).
- 16.12.2004.** IMMM SAS Patronka
Manufacturing of metal matrix composites by pressure infiltration method in large scale autoclave. Al₂O₃ plates were mounted in special holder (holder was in a autoclave). In autoclave was Pb. After rising the temperature and pressure (5 MPa) Pb was infiltrated in alumina plates (150 x 240 mm). This

type of plates are used as a new type of battery.

- 17.12.2004.** IMMM SAS Racianska
Testing of creep properties of titanium based intermetallic alloys $TiAl_3$ (Ti + 46% Al). Several testing units are connected with computers. Titanium based intermetallic alloys are used for turbine blades manufacturing.
- 18.12.2004.** Leaving Bratislava.

Results of STSM

I have learned the following techniques:

- samples preparation for thermal spraying (plasma and gas)
- plasma spraying of ceramic coatings (Al_2O_3 , ZrO_2)
- gas spraying of Ni_3Al powder
- measuring of coating properties
- production method of aluminium foam with closed cells and with and without reinforcement
- production of metal matrix composites (alumina plates infiltrated with Pb)
- determination of creep properties of titanium based intermetallic alloys

Future prospects

- further investigation of coating type for improved tribological properties of contact surfaces
- introduction of advanced metallic materials research in Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb
- possible collaboration with Dr.ing. Simančik in FP6 Extremat project (Composite materials for extreme environmental)

Zagreb, 12.01.2005.

Ivan Kramer
University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
Department of Materials
Zagreb, Croatia

Details of my employer and bank account:

Address: University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
Department of Materials
I. Lucica 5
10000 Zagreb
Croatia

Bank acc.: Zagrebacka banka
Savska 66
HR-10000 Zagreb
Croatia
2360000-1000000013
S.W.I.F.T. ZABA "HR" 2X 2500-3276546

Ivan Kramer
B. Magovca 68
HR – 10000 Zagreb
Croatia