FRANTSEVICH INSTITUTE FOR PROBLEMS OF MATERIALS SCIENCE OF NATIONAL ACADEMY OF SCIENCES OF UKRAINE.

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Founded in
1952
on a territory of Kiev-Pechersky Monastery

SINCE 1952
THE IPMS WAS WORKING IN PART OVER DEFENSE RELATED PROBLEMS

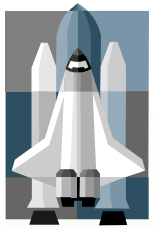
Materials and parts for sub-marines and ships

Until 1991 IPMS was a headquarter center for powder metallurgy & composite materials in the former USSR

Vehicle and body protection armored systems

development materials and parts for ballistic missiles and aircrafts

Since 1991 we switched to non-proliferation and conversion strategy !



IPMS OVERWIEW

Main directions of research in the
Frantsevich Institute for Problems of Materials Science of NAS of Ukraine

I. **Physicochemical fundamentals of materials science**; phase equilibrium research, surface and contact phenomena in the multicomponent systems; technologies of synthesis and treatment of materials;

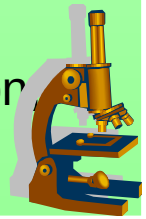
II. **Physical metallurgy, physics of strength and plasticity**; structure engineering of structural materials with extreme specific strength; computer modeling of materials structure;

III. **Materials science of high melting compounds and high pressure phases**; high melting point, superhard and functional non-oxide and oxide ceramic materials on their basis;

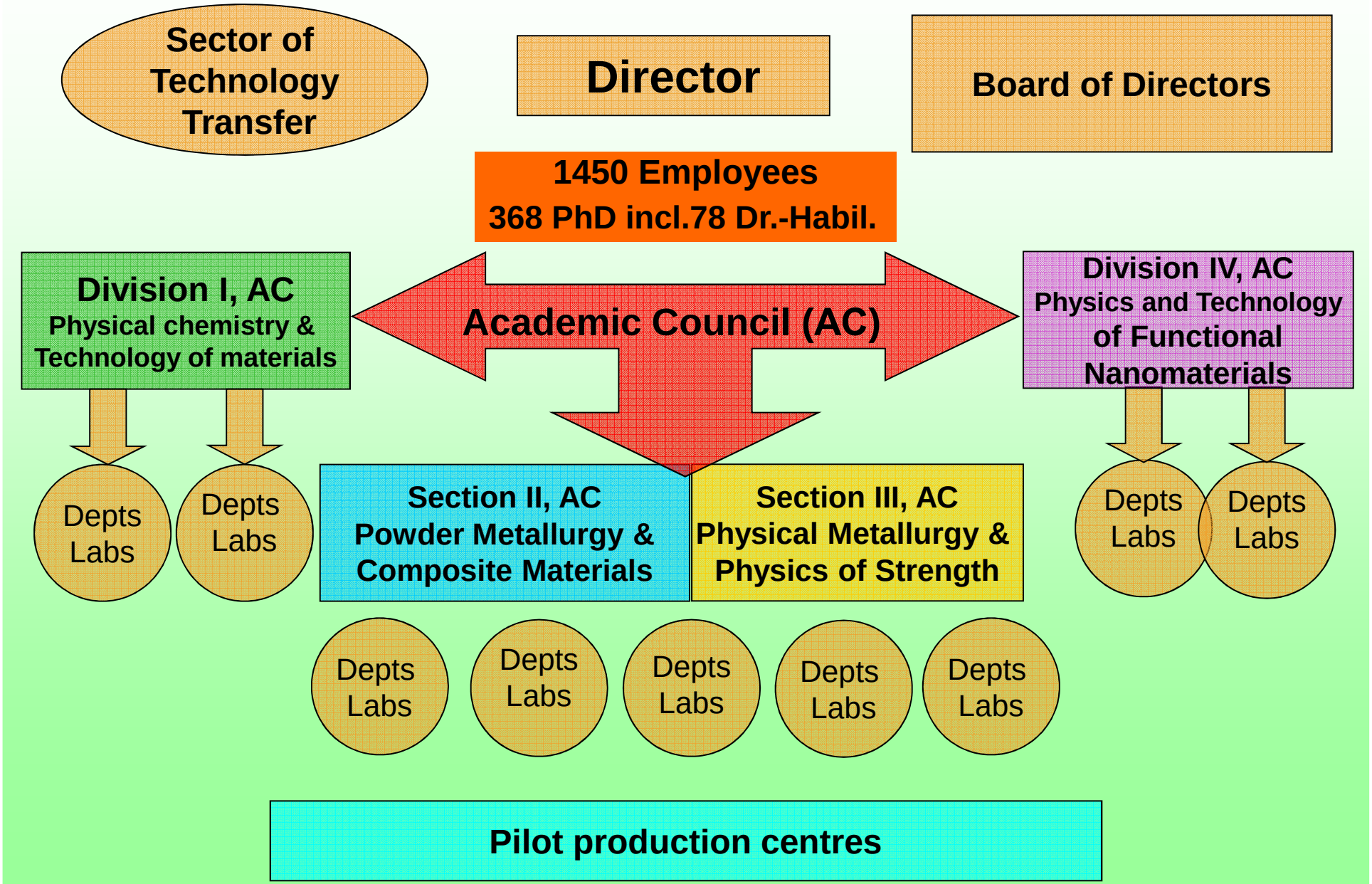
IV. **Novel powder metallurgy processes and technologies;** computer engineering modeling and optimization of technological processes; sintered metallic and composite materials and powder coatings with given properties for various applications;

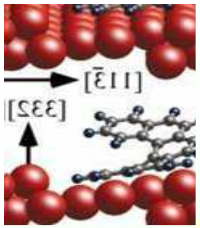
V. **Nanostructured materials;** synthesis and characterization of new nanostructures, study of size effects, technology development.

VI. **Materials for Hydrogen energy engineering systems**; hydrogen production, storage, applications

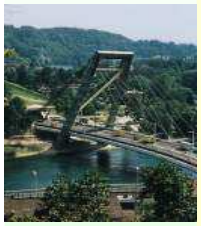


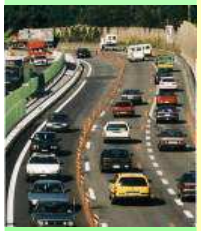
Organizational structure of the Materials Science institute





Scientific and technological facilities





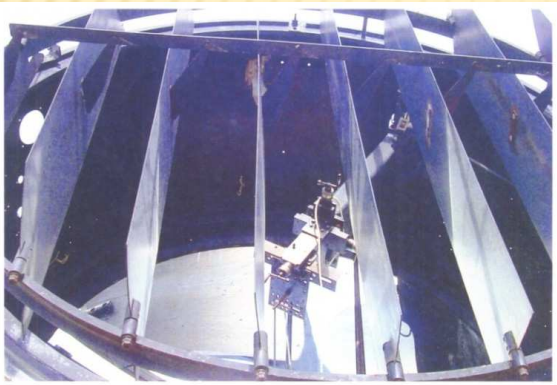
- **40 departments** have well-equipped laboratories;
- **4 technological centers** concentrated on small batch production;
- Equipment is gradually renewed, for instance: HRTEM JEOL 2100F, VG9000 mass spectrometer, Zetasizer, Micro-nanoindenter, ASAP 2010, X-Ray Fluorescent analyzer Rigaku, Dimatics-ink-jet, tape casters, laminator, screen printer, CIM mashine, SPS machine, furnaces, various testing installments;
- Several laboratory-scale and pilot-scale technologies are of the World-class ones;
- **Computer network of 540 PC** connected in 4 local net loops with 6 servers.
- There is an **electronic library** of journals and abstracts – the powerful resource accessible from each PC of intranet.
- **Large work area – 81000 m^2, including 4 pilot plants of 2000 m^2 each equipped with technological units and communications**

CRIMEAN HELIOCENTER OF IPMS NAS OF UKRAINE

Assembly, testing and research of characteristics of the heat-pipe SC are conducted at IPMS NASU Heliocenter.

“Helios-center” testing ground at the southern coast of the Crimea (town of. Katsiveli, the Big Yalta) aimed at improvement of solar technologies and solar equipment.

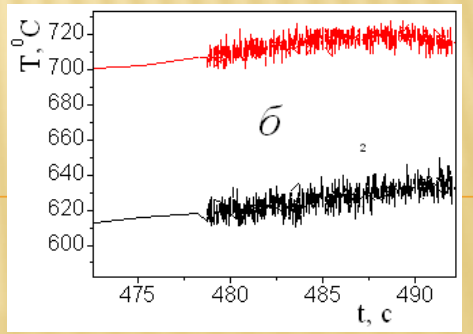
DEPARTMENT OF PHYSICAL AND CHEMICAL BASIS FOR POWDER METALLURGY MATERIALS TECHNOLOGIES, HEADED BY IPMS DIRECTOR PROF. ACADEMICIAN OF NASU VALERII SKOROKHOD AND LEADER PROJECT TEAM DOCTOR VICTOR SOLNTSEV



Full cycle of the development of two kinds of materials in the framework of WP2 project activity
Ni-Cr based materials
Nb-based materials

Reading of thermocouples installed along the length of the sample from the heated surface:

1 - 2 mm,
2 - 6 mm.



Computerized system for measuring temperatures to study thermokinetics of oxidation and reactionary interaction

DEPARTMENT OF STRUCTURAL CERAMICS AND CERMETS LEADED BY DOCTOR OF SCIENCE AND CORRESPONDING MEMBER OF NASU OLEG GRIGORIEV

Main scientific area – development and investigation of ultra high temperature ceramics – WP4 project activity

Production technologies for initial powders (including composite powders) for UHTC

Compositions for new ceramics to be used in energetics (flame tubes);

Pilot production technology of new ceramics and large sized ceramic products (plates, rings) based on hot pressing method .

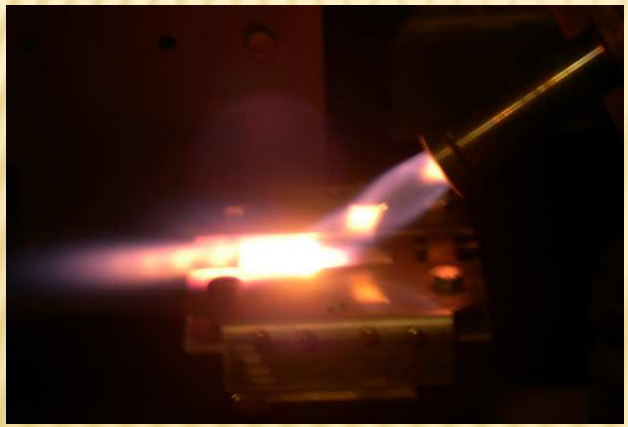
Hot pressing facility for UHTC production

UHTC lining plates of flame tubes

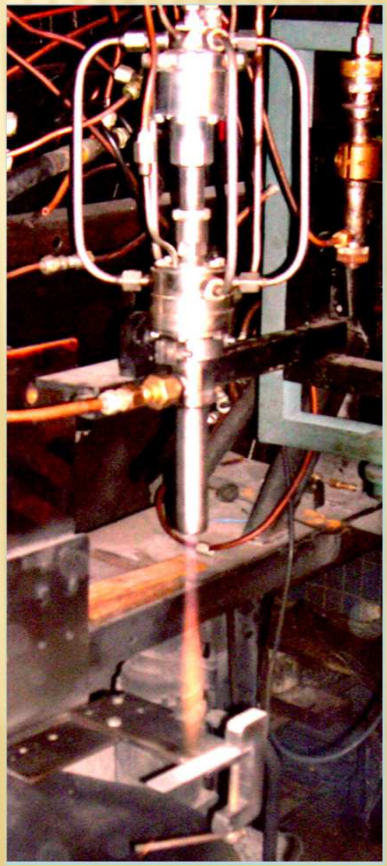
DEPARTMENT OF HIGH TEMPERATURE PROCESSES AND SPACE-ROCKET MATERIALS INVESTIGATIONS leaded by project scientific manager PROF . GENNADY FROLOV
responsible executor VYACHAESLAV KYSIL

This experienced scientific team take part in the following areas of project activity

- Investigations of the samples of thermo resistant materials under radiation and convective heating
- Coating deposition on metal substrates
- Thermo erosion testing



Thermoerosive tests of ZrB_2-SiC($ZrSi_2$) ceramics



Two-chamber burner "Grad VM"

WP1	Technical requirements definition (2 person-months)
D1.3 :	Selected Ni-Cr/Nb alloys compositions for the development of the TPS metal frame (Technalia, coordinator)

WP2	Development of powder alloys on the basis of NiCr and Nb for heat resistant metallic frame of TPS (23 person-months)
D2.1	Technology for powder Ni-Cr material obtaining. Technical report. Contains the results of the Task 2.1 implementation
D2.2	Ni-Cr based 1st powder batch for the construction of the TPS elements
D2.3	Ni-Cr based 2nd powder batch for the construction of the TPS elements
D2.4	Technology for powder Nb-based alloy material obtaining. Technical report. Contains the results of the Task 2.2 implementation.
D2.5	Nb-based 1st powder batch for the construction of the TPS elements
D2.6	Nb-based 2nd powder batch for the construction of the TPS elements
D2.7	Complex tests report. Describes the tests methodology and results

WP3	Development of super-light multilayer TPS for reusable space systems (9 person-months)
D3.1	IPMS contribution to technical report on honeycomb metallic frame development. Integrates the results obtained within tasks 3.1-3.2
D3.2	IPMS contribution to overall TPS design. Technical Report providing detailed constructional design of the TPS
WP4	**Development of UHTC and gradient coatings on its basis for metallic and non-metallic materials (25 person-months)**
D4.1	IPMS contribution to technical report on microstructural characterization of the sintered materials and preliminary thermo-mechanical characterization. Definition of the best compositions for the development of the UHTC coating
D4.2	IPMS contribution to technical report on the advanced thermo-mechanical properties of the selected UHTCs
D4.3	IPMS contribution to PCM 1st batch on the basis of ZrB2-SiC for thermal spraying
D4.4	IPMS contribution to PCM 2nd batch on the basis of ZrB2-SiC for thermal spraying
D4.5	PCM 1st batch on the basis of ZrB2-MoSi2 for thermal spraying

D4.6	PCM 2nd batch on the basis of ZrB2-MoSi2 for thermal spraying
D4.7	IPMS contribution to 1st group of non-metallic structures for coating optimization
D4.8	IPMS contribution to 2nd group of non-metallic structures for coating optimization
D4.9	IPMS contribution to technical report on the development of PCMs for thermal spraying
D4.12	Technical report on the development of gradient coatings by high velocity combustion spraying
D4.13	IPMS contribution to technical report on the advanced characterization of coatings
WP5	**Dissemination, Education, Exploitation (3 person-months)**
WP6	Technical coordination and risk management (4 person-months)

TECHNIQUES FOR TESTS OF MATERIALS

The our installations allow us to spend following kinds of researches:

1 Determination of the thermal conductivity of UHTC materials at the surface temperature up to 1800 °C.

2 Thermo erosion testing of heat-protective materials specimens at the surface temperature up to 1500 °C.

3 Determination of the integrated emittance at the surface temperature up to 1000 °C.

4 Resource tests of thermal-protective packages on SGU-6 heliostand sized at least 50x50 mm at the surface temperature up to 1200 °C and specimens sized of ∅15 mm on convective stand with a duration of one heating cycle up to 20 minutes

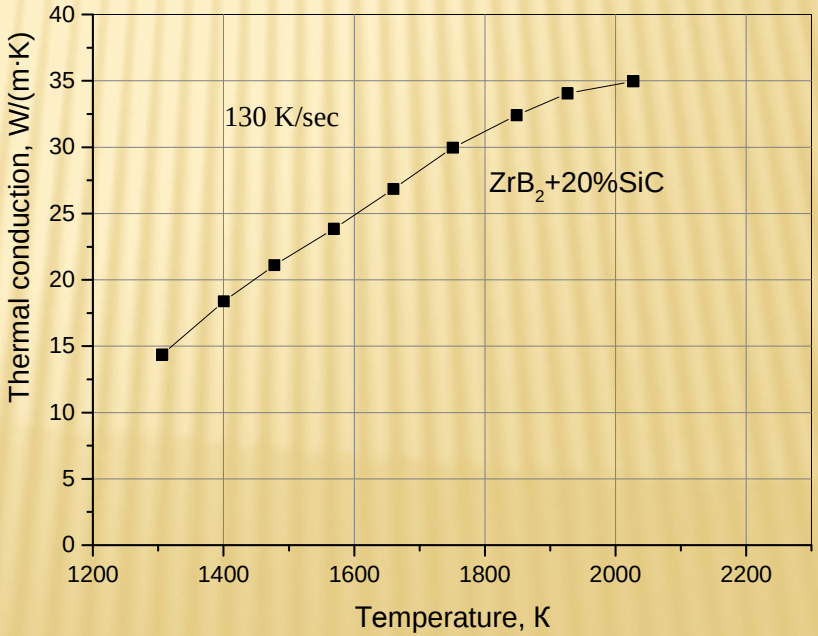
5 Test of specimens at the surface temperature up to 1800 °C on gasdynamic stand of Institute for Problems of Strength of NAS Ukraine

6 **High velocity gas-thermal spraying of non-metallic materials on metallic substrates**

AIR- PLASMA STAND FOR HIGH TEMPERATURE TESTS OF HEAT PROTECTIVE MATERIALS AT CONVECTIVE HEATING

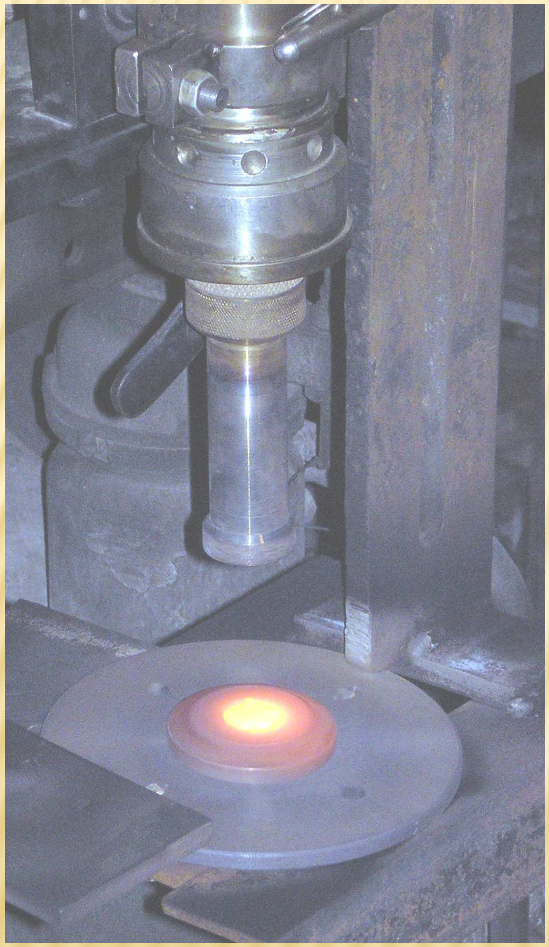
Air-plasma stand allows to determine the thermal conductivity of UHTC ceramic samples

Air- plasma stand VPS-1000 L
based on electroarc heater
Parameters:
Diameter of specimens: 20…50 mm
Braking enthalpy up to 15 000 kJ/kg
Heat flow: up to 5 000 kW/m²



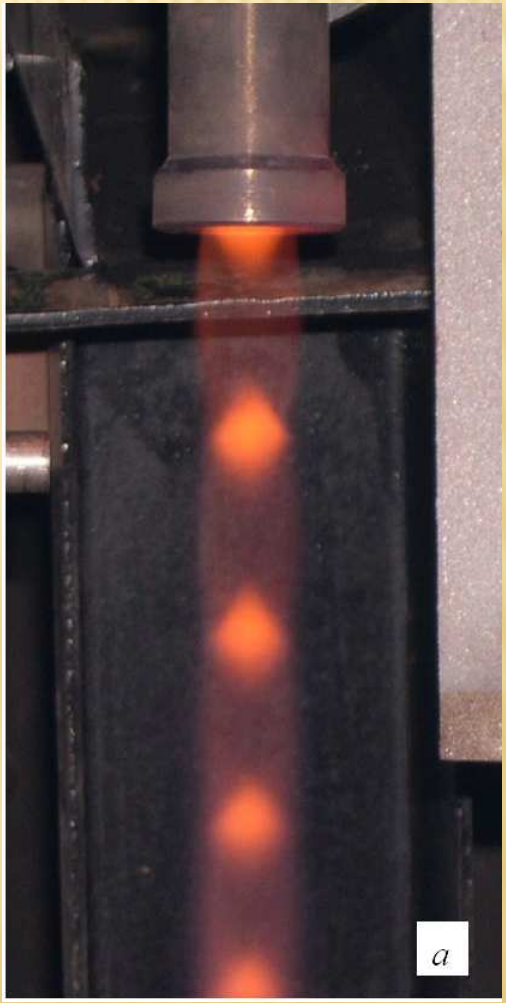
GENERATORS OF HIGH TEMPERATURE GAS FOR TESTS OF HEAT PROTECTIVE MATERIALS AT CONVECTIVE HEATING

The generators can work both on fuel kerosene-air, and on fuel kerosene-oxygen, and also to conduct tests of heat protective materials in two-phase gas flow



Fuel pair: kerosene-air
Pressure in combustion chamber: 0.8 MPa
Oxidizer surplus factor: 1.8
Speed of gas stream: 1100 m/s
Diameter of specimens: 20 mm
Temperature of gas flow: 2000 K
Temperature of heating surface of specimen: up to 1500 ^{o}C
Time of heating: 20 min

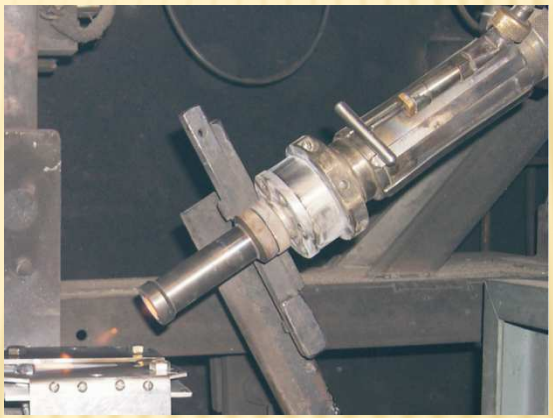
Fuel pair: kerosene-oxygen
Pressure in combustion chamber: 0.8-1.0 MPa
Oxidizer surplus factor: 1.2
Speed of gas stream: 2.2 M
Diameter of specimens: 15 mm
Temperature of gas flow: 3000 K
Time of heating: 60 s
Heat flow: up to 45 000 kW/m^2



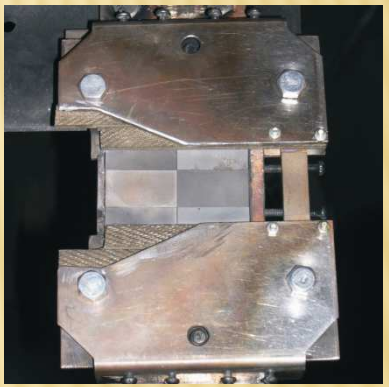
THERMOEROSIVE TESTS OF ZrB_2-SiC($ZrSi_2$) CERAMICS

Thermoerosive tests carried out in supersonic a gas-dust stream of the kerosene in air combustion products with abrasive particles at the universal thermojet stand. Pressure in the combustion chamber of the two-phase gas generator at critical section diameter of 11 mm made 1.2 MPa. It provided speed of a gas stream of 1650 m/s and of braking temperature of 2100 °C.

Control panel of the universal thermojet stand



Two-phase gas generator



Holder with the sample

The sample before tests with the sizes of 34×20×5 mm

IPMS PROJECT TEAM TECHNOLOGICAL FACILITIES

- Furnace (up to 1100 C) for production of composite alloys nanopowders using chemical reduction in hydrogen atmosphere

IPMS PROJECT TEAM TECHNOLOGICAL FACILITIES

Press pressing of powder samples (up to 125 T) for the following sintering

Furnace for thermal processing Up to 1300 C and sintering and investigation of heat resistant in air environment

IPMS PROJECT TEAM TECHNOLOGICAL FACILITIES

- Equipment for sample testing in high radiation and convective flows

- THANK YOU FOR ATTENTION
- SUCCESS IN JOINT PROJECT ACTIVITY

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