

## PŘÍLOHA 2 : ANOTACE (anglicky)

### Stabilization of Corundum Alumina Phase in Thermally Sprayed Coatings

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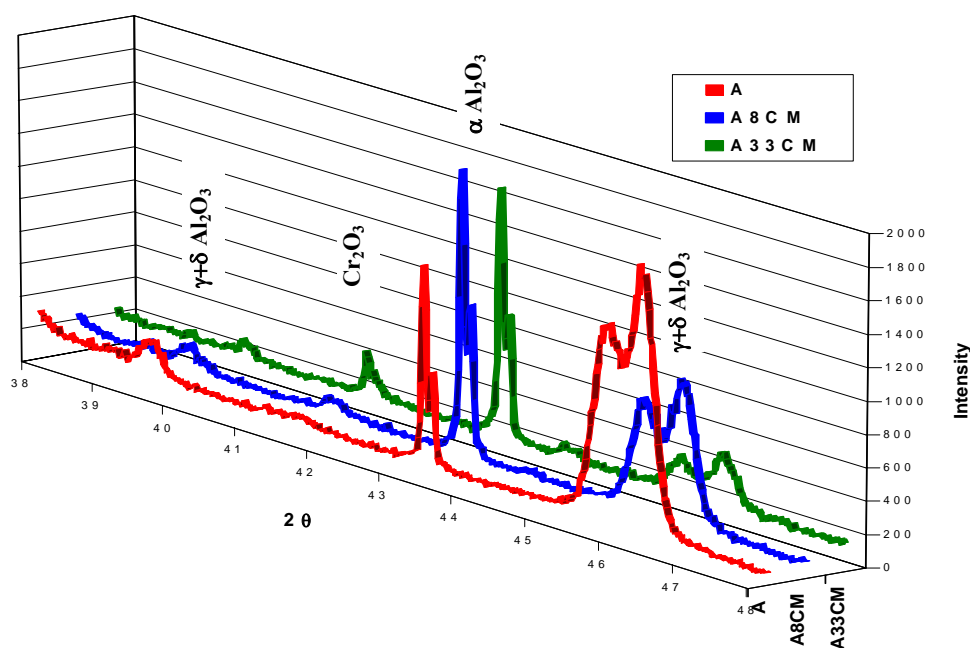
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Thermally sprayed ceramics is frequently used for various applications, such as formation of thermal barriers, protection coatings, anti-wear coatings, electric insulation, etc. Since Alumina in the Corundum form, i.e.  $\alpha$ -Al<sub>2</sub>O<sub>3</sub>, is relatively a non-expensive material with good properties it is often used as feedstock for thermal spraying. However, due to complex processes during spraying  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> phase is also formed in deposits which has a spinel structure, unstable at elevated temperatures, when it gradually transforms to more stable  $\delta$  or  $\theta$ -Al<sub>2</sub>O<sub>3</sub>. Ways of stabilizing  $\alpha$ -Al<sub>2</sub>O<sub>3</sub> in sprayed deposits are sought - one of them is addition of another oxide to the Alumina feedstock. Chromia Cr<sub>2</sub>O<sub>3</sub> has been suggested as this stabilizing admixture because it has the same crystal structure and there is the total miscibility of both oxides above 1260°C. The resulting as-sprayed structure then contains a complex corundum type  $\alpha$ -(Al,Cr)<sub>2</sub>O<sub>3</sub> phase.

Alumina feedstock with admixture of varying amount of Chromia was produced either as fused and crushed powder or as a blend of two single powders. Characteristic of the coatings made by the water stabilized plasma (WSP<sup>®</sup>), by a commercial gas stabilized system (APS) and by High Velocity Oxygen Fuel (HVOF) technologies were compared.

Several differences were recorded in the resulting coatings related to the used technology and the feedstock type. In general, coatings made by WSP<sup>®</sup> spraying, regardless of the used feedstock, contained mostly  $\alpha$ -(Al,Cr)<sub>2</sub>O<sub>3</sub> and some  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> and tetragonal  $\delta$ -Al<sub>2</sub>O<sub>3</sub> phases, During the dwell time at the WSP<sup>®</sup> jet obviously even the injected particles from the blended feedstock melted and sufficiently interfused allowing formation of the complex oxide. That was evidently not the case at APS spraying of blended feedstock, when no or small amount of the corundum type  $\alpha$ -(Al,Cr)<sub>2</sub>O<sub>3</sub> oxide phase was found while more was found when fused feedstock was used. Interesting results were recorded also regarding the size of the Chromia powder used for blending: the smaller the Chromia powder, the more the corundum phase. Higher enthalpy content of the WSP<sup>®</sup> jet is viewed as the primary source of the registered differences in formation of  $\alpha$ -(Al,Cr)<sub>2</sub>O<sub>3</sub> phase.

This work was made in international cooperation with Fraunhofer Institute, Material and Beam Technology, Dresden, Germany and the Center for Thermal Spray Research, State University of New York at Stony Brook, USA. Results were summarized in several publications and conference papers. Summary is, for instance, in: C.C.Stahr, S. Saaro, L.-M. Berger, J. Dubský, K. Neufuss, M. Herrmann: Dependence of Stabilization of  $\alpha$ -Alumina on the Spray Process, J. Therm. Spray Techn. **16** (2007) 822-830.

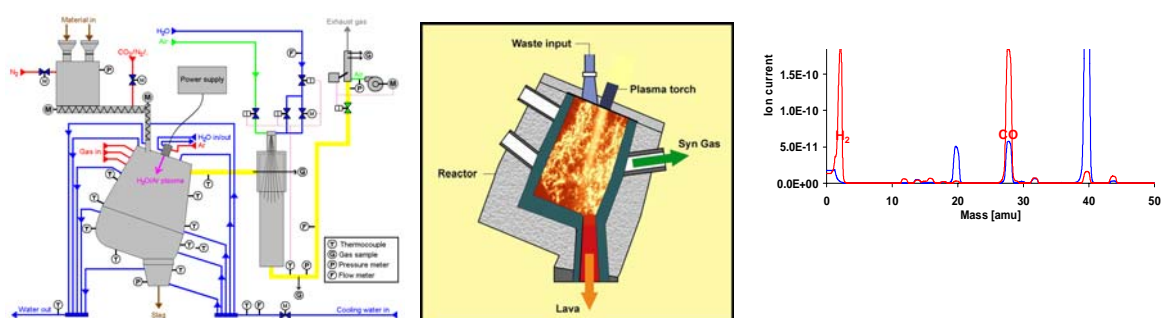


X-ray diffraction patterns of coatings prepared by WSP<sup>®</sup> spraying of mechanical mixtures of Al<sub>2</sub>O<sub>3</sub>-Cr<sub>2</sub>O<sub>3</sub> with 0, 8 and 33 wt.% Cr<sub>2</sub>O<sub>3</sub> illustrates the decreasing amounts of metastable phases and increase of the corundum phase.

## Production of syngas by biomass gasification in plasma generated from water

Production of syngas by gasification of biomass in plasma generated from water was studied in experiments with plasmachemical reactor PLASGAS. The method of control of composition and quality of syngas by addition of oxidizing gases into the plasma reactor for gasification of biomass was verified. Advantages of biomass gasification in thermal plasma generated in hybrid gas/water torch were proved by analysis of experimental as well as theoretical results. The properties of high-enthalpy plasma generated in world-unique patented plasma torch with water/gas arc stabilization ensure high quality and high heating value of syngas, and moreover, CO<sub>2</sub> or steam can be used as oxidizing media. The ratio of heating value of produced syngas to plasma torch power is more than 3.5 and the process offers possibility of recycling of CO<sub>2</sub> to CO. The process is suitable for treatment of waste material and biomass, which can not be gasified by conventional methods. The European patent application was supplied.

- a. M. Hrabovsky, M. Konrad, V. Kopecky, M. Hlina, T. Kavka, O. Chumak, *Production of Biosyngas by Gasification in Steam Plasma*, Proc. of 18<sup>th</sup> Int. Symp. on Plasma Chem., Kyoto, August 26-31, 2007, Book of Abstracts, 708, full paper on CD.
- b. M. Hrabovsky, *Plasma Pyrolysis and Gasification of Biomass for Syngas Production*, Int. Round Table on Thermal Plasma Applications, Sharm El Sheikh, Egypt, Jan 14-18, 2007, invited lecture.
- c. M. Hrabovsky, M. Konrad, V. Kopecky, M. Hlina, *Pyrolysis of wood in arc plasma for syngas production*, Journal of High Temperature Material Processes **10** (4), 2006, pp. 557-570.
- d. M. Hrabovsky, M. Konrad, V. Kopecky, M. Hlina, T. Kavka, G. van Oost, E. Beeckman, B. Defoort, *Gasification of biomass in water/gas-stabilized plasma for syngas production*, Czechoslovak Journal of Physics, Vol. 56 (2006), Suppl. B, B1199-1206.
- e. M. Hlina, M. Hrabovsky, V. Kopecky, M. Konrad, T. Kavka, S. Skoblja, *Plasma gasification of wood and production of gas with low content of tar*, Czechoslovak Journal of Physics, Vol. 56 (2006), Suppl. B, B1179-1184.
- f. M. Hrabovský, *Treatment of Waste Materials in Thermal Plasma*, 13<sup>th</sup> Int. Congress on Plasma Physics, Kiev, May 22-26, 2006, paper ITD21, Pt II., p.187, invited lecture.



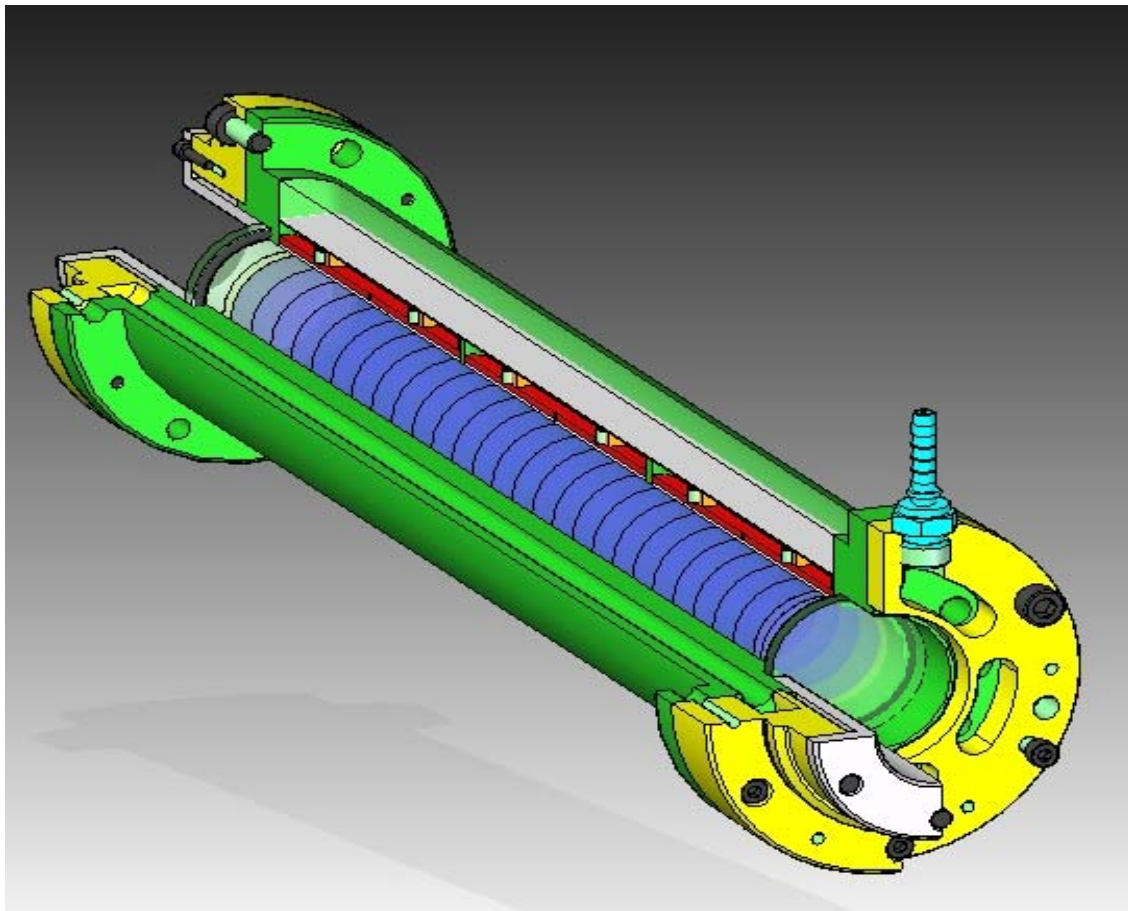
Scheme of plasma reactor PLASGAS and mass spectrum of syngas produced by gasification of wood. For comparison the mass spectrum of gas leaving the reactor when no wood is supplied (plasma) is shown.

## Development and production of narrow-band filters for chromosphere telescopes

Solar observation is continually in front of an astronomical society interest. This is the reason for building of new big solar ground telescopes and launching of similar ones into space. Basic data are collected by so-called chromospheric telescopes that take advantages of extremely narrow-band filters for solar observations. One of construction possibilities of these atypical filters was developed by Czech scientist RNDr. Ivan Šolc, CSc. His name gives to this specific filter a name. In the Optical Development Workshop, a part of the Institute of Plasma Physics AS CR, v.v.i, was developed and in these days is realized an unique polarization-interference filter that is able to observe on several astronomically interesting spectral wavelengths. This system is based on a long-term knowledge in crystal optics. It is a unique system that the detailed astronomical observations of the solar chromosphere makes possible.

The entire system is compounded of several sub-systems that can be tuned by temperature changes or by inclination to required solar spectral line. Numerous complex technical problems were solved and it is supposed the filter enables new ways of solar chromosphere observation.

As a unit, together with the filter, it is solved an imaging system. It is designed as an atypical off-axis meniscus-mirror objective that enables an aberration-less imaging in wide spectral region. Also the imaging on CCD detector is solved. Optical tests of developed imaging system give an assurance that data got by this complex system will be of superior quality. Emeritus coworker RNDr. Ivan Šolc, CSc, who was honored by František Křižík medal in field of technical sciences and for scientific results realization by the chairman of AS CR in 2007, participates actively on the development of this system.



Drawing of auxiliary support cell of narrow-band birefringent filter Šolc type. It serves for support of accurately oriented phase plates made of crystalline SiO<sub>2</sub> in thermo regulated box of main device.