Composites on the basis of glass fibres and siloxane matrix for the application at high temperatures

K. Balík, J. Křena, F. Kolář, Z. Weishauptová and B. Cabrnoch

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Main investigator: Karel Balík [1)]
Joint investigators: Josef Křena [2)]
Scientific collaborators: František Kolář [1)], Zuzana Weishauptová [1)] and Bohuslav Cabrnoch [2)]
1) Institute of Rock Structure and Mechanics Academy of Sciences of the Czech Republic, V Holešovičkách 41, 182 09 Praha 8
[2)] Letov-ATG Ltd., Beranových 65, 199 02 Prague 9, Czech Republic

Abstract
2-D composites based on E-glass or R-glass and two types of siloxanes were prepared. The mechanical properties e.g. flexural strength, flexural moduli, shear moduli and structure were measured and studied after HTT at 400, 500, 600 and 700°C. The tests of oxidation resistance at 400 and 700 °C showed that these composites can be used as a refractory material up to 700 °C without destruction. Developed composites can be used as cups or coverings of thermal devices.

KEYWORDS: ceramics, composite materials, heat treatment, chemical techniques, fracture and toughness, fatigue, defects, fracture, heterostructures, thermal properties

Quantitative analysis of a reinforcing fabric structure as a prerequisite for modelling the mechanical properties of composites

B. Košková, P. Glogar, Miloslav Černý

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Main investigator: Bohumila Košková [1)]
Joint investigators: Petr Glogar [2)] and Miroslav Černý [3)]
Scientific collaborators: Miloslav Košek [1)], Bohdana Marvalová [1)] and Stanislav Vopička [1)], Martin Černý [2)], Jiří Gregor [2)] and Jan Zeman [3)]
[1)] Technical University in Liberec, Hálkova 6, 46117 Liberec 1, Czech Republic
[2)] Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic, V Holešovičkách 41, 182 09 Prague 8, Czech Republic
[3)]Klokner Institute, Czech Technical University Prague, Šolínova 7, 166 08 Prague 6, Czech Republic

Abstract
Specimens of carbon-carbon composites with plain-weave, twill, or satin fabric reinforcement and varying fiber volume fraction were achieved by compressing the prepreg layers to different levels. Equipment was developed for scanning under microscope the specimen cross-sections and their processing using image analysis, which enabled to achieve large sets of structural data. Quasiperiodic courses of the undulated reinforcing yarns were approximated using a discrete Fourier transform technique. From the spectra, actual wavelength of the crimp wave and the yarn deformation in the composite were deduced. New information was gained on actual geometric arrangement of the reinforcement, which can be exploited in advanced models for refinement of both numeric and analytical prediction of elastic composite properties. Investigation into the influence of the compression degree on the geometric parameters of the reinforcing fabric contributed to understanding the role of woven fabric in composites. Calculated values of the elastic moduli were verified by resonant frequency measurements based on newly developed theory of vibration of planar and cylindrical orthotropic bodies.

KEYWORDS: fabric reinforced composite, image analysis, spectral analysis, elastic properties

A study of surface properties of composite materials and their influence on the biocompatibility

V. Starý, P. Glogar, L. Bačáková

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Main investigator: Vladimír Starý[1)]

Joint investigators: Petr Glogar [2)] and Lucie Bačáková [3)]

Scientific collaborators: František Hnilica [1)], Václav Chmelík [1)], Zdeněk Kořínek [1)], Jiří Gregor [2)], Vladislav Mareš [3)] and Věra Lisá [3)]

[1)] *Czech Technical University, Faculty of Mechanical Engineering, Karlovo nám. 13, Prague 2, Czech Republic*

[2)] *Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic, V Holešovičkách 41, 182 09 Prague 8, Czech Republic*

[3)]*Institute of Physiology, Academy of Sciences of the Czech Republic, Vídeňská 1083, Prague 4, Czech Republic*

Abstract

The project aimed at deposition onto the carbon-carbon composites substrates of surface layers made of various carbon modifications with properties governed by their structure, characterization of engineering, physical and chemical properties of the layers and substrates, and investigation of the influence of important properties on the layer biocompatibility by measuring cell adhesion, proliferation and other features. Carbon-carbon composites coated with amorphous carbon (a:C-H), pyrolytic carbon (deposited at 850°C or 1900°C), titanium-carbon (Ti:C), or chromium-carbon (Cr:C) layers were employed for biocompatibility tests in vitro. To pursue interaction of the composites with vascular smooth muscle cells, and human osteosarcoma-derived MG63 cells were studied. Coating with pyrolytic carbon and with Ti:C layer proved to be most stable from the viewpoint of releasing particles of carbon substrate or the surface layer, as well as of cell adhesion and proliferation. The influence of surface roughness of the pyrolytic carbon coating on the mentioned cell adhesion and proliferation was investigated in detail. The results have revealed that surface treatment of carbon-carbon composites is a promising way to improve their implementation to medicine. Coating of the composites with pyrolytic carbon is most suitable especially if supplemented with grinding and polishing.

KEYWORDS: carbon-carbon composites, pyrolytic carbon, mechanical properties, biocompatibility

Composition and mode of occurrence of the mineral constituents in brown coal, and their behaviour at fluidized bed combustion

I. Sýkorová, J. Smolík, J. Pešek and V. Machovič

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Main investigator: Ivana Sýkorová [1)]
Joint investigators: Jiří Smolík [2)] , Jiří Pešek [3)] and Vladimír Machovič [4)]
Scientific collaborators: Eva Melichárková [1)], Lenka Borecká [1)], Michal Vašíček [1)], Jaroslav Schwarz [2)], Lucie Džumbová [2)], Jan Kučera [5)], Vladimír Havránek [5)] and Anna Langrová [6)]
[1)]*Institute of Rock Structure and Mechanics, V Holešovičkách 41,182 09 Prague 8, Czech Republic*
[2)]*Institute of Chemical Process Fundamentals AS CR, Rozvojová 135, 165 02 Prague 6*
[3)] *Charles University, Faculty of Sciences, Albertov 6, 128 43 Prague 1*
[4)] *Institute of Chemical Technology, Technická 5, 160 00 Prague 6, Czech Republic*
[5)] *Institute Nuclear Physic Institute, 250 68 Řež et Prague, Czech Republic*
[6)] *Geological Institute AS CR, Rozvojová 135, 165 02 Prague 6, Czech Republic*

Abstract
The paper compiles results of the study of elemental and mineralogical composition of brown coals, and the influence of commercial additives on the amount and composition of solid emissions from fluidized bed combustion. Attention has been paid to mode of occurrence of selected elements in the coal matter and to the stability of fly ashes in aquatic and acidic environment.

KEYWORDS: brown coal, fluidized bed combustion, emissions, sulfur, trace elements, mineralogical composition

Thermal history of sedimentary basins of the Czech republic and its relation to tectonic processes

J. Šafanda, V. Suchý, I. Sýkorová, M. Stejskal

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Main investigator: Jan Šafanda [1)]
Joint investigators: Václav Suchý [*2)] , Ivana Sýkorová [3)] and Michal Stejskal [4)]
Scientific collaborators: Jiří Filip [2)], Vladimír Machovič [4)], Lenka Borecká [3)] and Petr Dobeš [5)]
[1)]*Geophysical Institute AS CS, Boční II/1401, 141 31 Prague 4, Czech Republic*
[2)]*Institute of Geology AS CS, Rozvojová 135, 165 00 Prague 6, Czech Republic*
**Present address: National Technical Museum, Kostelní 42, 170 78 Prague 7, Czech Republic*
[3)]*Institute of Rock Structure and Mechanics AS CS, V Holešovičkách 41,182 09 Prague 8, Czech Republic*
[4)]*Institute of Chemical Technology, Technická 5, 160 00 Praha 6*
[5)]*Czech Geological Survey, Klárov 3, 118 21 Prague 1, Czech Republic*

Abstract
The project was aimed at investigation the present-day and ancient geothermal conditions in major sedimentary basins of the Czech Republic and establish a link between its geothermal history and tectonic development. The studies involving illite crystallinity, light reflectance of organic matter, apatite fission-track analysis, gas chromatography-mass spectrometry, infrared spectrometry and thermal modeling were undertaken to evaluate coal rank, thermal stability, thermal impact of igneous intrusions, tectonics and migration of geofluids in lower Paleozoic sediments of the Barrandian basin, and thermal history of the Upper Proterozoic rocks forming the basement of the Barrandian. Thermal modeling was also used in research of subsurface temperature field of the Bohemian Cretaceous Basin, and in study of the effects of magmatic activity on the temperature field of the upper crust in the Cheb and Sokolov basins.

KEYWORDS: thermal history, tectonics, sedimentary basins, organic matter reflectance, coalification, illite crystallinity, fluid inclusions, apatite fission-track analysis, lineaments, hydrothermal karst, Lower Paleozoic, Barrandian Basin

Recent Geodynamics of West Bohemia in Relation on the Crustal Structure (Unique Natural Laboratory)

J. Horálek, M. Brož, V. Nehybka, O. Novotný, J. Ulrych and J. Kotková

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Main investigator: Josef Horálek [1)]

Joint investigators: Milan Brož [*2)], Vladimír Nehybka [3)], Oldřich Novotný [4)], Jaromír Ulrych [5)] and Jana Kotková [6)]

Scientific collaborators: Axel Plešinger [1)], Tomáš Fischer [1)], Vladislav Babuška [1)], Jan Šílený [1)], Aleš Špičák [1)], Jan Mrlina [1)], Josef Pek [1)], Jan Šafanda [1)], Alena Boušková [1)], Alice Slancová [1)], Petr Jedlička [1)], Ivan Pšenčík [1)], Václav Červ [1)], Vladimír Čermák [1)], Oldřich Praus [1)], Jaroslava Plomerová [1)], Jiří Málek [2)], Radim Číž [2)], Vladimír Rudajev [2)], Jan Švancara [3)], Josef Havíř [3)], Zuzka Skácelová [3)], Zdeňka Sýkorová [3)], Jaromír Janský [4)], Zdeněk Vejnar [5)], Vladimír Cajz [5)], Jiří Fiala [5)], Čestmír Nekovařík [6)] and Bedřich Mlčoch [6)]

[1)]Geophysical Institute, Academy of Sciences of the Czech Republic Boční II., 1401 141 031 Praha 4 – Spořilov

[2)]Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic, V Holešovičkách 41, CZ-182 09 Praha 8, Czech Republic

[3)]Ústav fyziky Země, přírodovědecké fakulty MU v Brně, Tvrdého 12, 621 00 Brno

[4)]Faculty of Mathematics and Physics UK, V Holešovičkách 2, 180 00 Praha 8, Holešovice

[5)]Institute of Geology, Academy of Sciences of the Czech Republic, Rozvojová 135, 165 02 Praha 6, Suchdol

[6)] Czech Geological Institute, Klárov 3, 118 21 Praha 1

Abstract

The aim of the project was to conduct interdisplinary geophysical, geodetic and geological research in the West Bohemian/Vogtland earthquake swarm region. It was expected that the joint interpretation of geophysical, geodetic and geological data from this challenging natural laboratory might contribute substantially to the understanding of the relations among frequent earthquake swarms, surface deformations, subrecent volcanism, heat-flow, activity of mineral springs and crustal structure. The results obtained have been relevant for explanation of the causes of recurrent accumulation of stress in the Earth's crust in the region resulting in repeated seismic energy release in the form of intensive earthquake swarms. The project tied in with two international projects: (1) the active refraction experiment CELEBRATION 2000 and (2) the lithospheric passive experiment BOHEMA. The project was conducted in close co-operation with German geoscience institutions. The parallel German seismological, seismo-tectonic, gravimetric, hydro-geochemical, geomechanical and geodetic studies in the West Bohemian/Vogtland region were carried out within the Bundle of eleven projects "Physical/chemical conditions and processes in the earthquake area Vogtland/NW Bohemia" granted by the German Research Company (Deutsche Forschungsgemeinschaft).

KEYWORDS: West Bohemia/Vogtland seismic region, recent geodynamics, earthquake swarms, recent stress and paleostress micro-gravimetry, geothermal model of the crust, magnetoteluric sounding, cainozoic volcanities

Measurement of elastic constants of orthotropic materials by resonant frequency method (doctoral thesis)

M. Černý

Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Republic, V Holešovičkách 41, 182 09 Prague 8, Czech Republic

Abstract

The aim of this article is detailed elaboration of measurement methodology of elastic constant of ortotropic composite materials by resonant frequency measurement. The theory and the methodology of measurement are described for two important shapes: plate and tube. In the theoretical part of the work sooner published results that concern harmonic vibration of ortotropic cylindrical shells and thin plate strips verified and modified. The discussed theoretical results are subsequently employed in proposed method of measurement. The proposed methodology allows evaluating longitudinal Young modulus, Poisson ratio and transversal Young modulus. Shear modulus is possible to evaluate from resonant spectrum of vibration. The method of measurement of shear modulus is possible to amplify also for general cross section of beam. The methodology proposed for cylindrical ortotropic shell allows evaluating axial Young modulus, tangential Young modulus and Poisson ratio. In the experimental part of the work proposed methodology was tested for all discussed cases and several experiments demonstrate the usage of proposed methods in the research and development of composite materials.

KEYWORDS: composites, anisotrotropy, measurement, elastic constants, plates, tubes, cylindrical shel, Timoshenko´s beam