Participant Profile

for the
Turkish-German Strategy Workshop 2006
TÜBITAK Marmara Research Center
Gebze, Turkey
13 – 15 December 2006

International Bureau (IB)
of the Federal Ministry of
Education and Research
(BMBF)

1. Contact details and personal information

Name:	Prof. Dr. Rainer Gadow	**Phone:**	++ 49 711 685 68301
Role/function[1]:	Managing Director	**Fax:**	++ 49 711 685 68299
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[1] **Role/function** e.g. working group leader, managing director, postdoc, PhD etc.
[2] **Organisation type** e.g. university, research institution, small and medium enterprise (SME), industry etc.

Working Group:

☒ 1 Material Technologies
☒ 2 Biotechnology, Genomics and Food
☒ 3 Energy
☐ 4 Information and Communication Technologies
☒ 5 Environmental Protection, Climate Change and Sustainable Development

Areas of activity:

☒ research	☒ training
☒ technology development	☐ dissemination
☐ demonstration	☐ other:

Keywords characterising your area of research:

Please choose the appropriate key words (max. 5) from the following list:
http://www.cordis.lu/fp6/keywords

Manufacturing engineering, Materials engineering, Lightweight structures, Nanotechnology, Biomaterial engineering

Expertise, technologies and infrastructures available in your institution:

Research activities / expertise:

1. Structural ceramics and fiber reinforced composite materials:

Metal matrix and ceramic matrix composites (MMC, CMC); thermal, textile and mechanical process engineering; C-fiber coating technology; deposition of diamond like carbon (DLC) and amorphous hydrocarbon layers; technical carbon materials; ceramics from silicon-organic precursors; transparent oxide ceramics; net-shape and near net-shape technologies such as ceramic injection molding (CIM), axial and cold isostatic pressing, slip casting, extrusion and viscous flow pressing; compounding, shaping and matrix consolidation; warm pressing; metal melt-infiltration of porous preforms; CF/RB-SiC and CF/SiSiC compounds for CMC brake disk systems; compounding and prepreg technology for thixoformed light metal composites; characterization of reinforcement fibers and CMC/MMC components; structural mechanics; wettability; micro-porosimetry and BET analysis.

2. Functional ceramics and chemical technologies:

Ceramic and powder-metallurgical raw material and compounding technology; spray dried granulates for axial and isostatic pressing; built-up granulates with short fibers and powder fillers for warm pressing of compound materials; characterization of feedstocks, suspensions and dispersions; rheological characterization of ceramic and carbon slurries and plasticized compounds; sintering and thermal treatment technology; heat treatment and furnace technology; finishing and machining; thermophysical and electrophysical properties of ceramic components and micro-devices; high voltage resistivity.

3. Surface technologies and layer composites:

Atmospheric plasma spraying (APS); high velocity oxy-fuel spraying (HVOF); arc wire spraying; hypersonic deposition techniques; ceramic precursor lacquer technology; metal, cermet, pre-ceramic and ceramic layer composite materials; combined polymer-ceramic coatings; coatings for biomedical applications; functional coatings for thermophysical and electrophysical applications; wear and corrosion protection coatings; interfaces and bonding; powder characterization; characterization of coatings and components; control technology; robotics and process automatization; metallurgy.

4. Material mechanics, process and component modeling and simulation:

Numerical and experimental thermal stress analysis using the finite-element-method (ABAQUS); heat and mass transfer and residual stress calculation in real component and composite geometries; materials modeling; experimental residual stress measurement on layer composites and functional surfaces; micro-hardness and elastic properties determination; manufacturing metrology, HR-3D-coordinate measurements; tactile and optical surface topography characterization; tensile, compressive, bending and adhesive strength measurements; X-ray and spectrographic materials characterization and properties.

Methods:

Manufacturing Methods: Ceramic injection molding (CIM), axial and cold isostatic pressing, slip casting, extrusion and viscous flow pressing; compounding, shaping and matrix consolidation; warm pressing; spray drying; milling (ball, bead, attrition etc.); metal melt-infiltration of porous performs; compounding and prepreg technology for thixoformed light metal composites; heat treatment and furnace technology; finishing and machining; atmospheric plasma spraying (APS); high velocity oxy-fuel spraying (HVOF); arc wire spraying; hypersonic deposition techniques; ceramic precursor lacquer coating techniques; combined polymer-ceramic coatings; robotics and process automatization.

Characterization Methods: Thermal analysis (DTA, DSC, TG and dilatometer); rheometrical measurements; porosimetry (Hg and BET); powder size characterization; suspension stability measurement (Zeta-potential); tactile surface roughness and profile measurements; microhardness measurement; impedance spectroscopy and electrochemical measurements; wetting angle and surface energy measurements; metallo- and ceramographical sample preparation techniques (thin section preparation, image analysis and imaging techniques with light and polarised light microscopes); tensile, compressive, bending strengths measurements, tribometry; 3D coordinates measurement and determining; resistivity measurements under high voltage.

Modelling and Simulation Methods: Finite element method (via ABAQUS); residual stress measurement; manufacturing metrology.

Key technologies: Ceramic manufacturing technologies; structural and functional ceramics and their composites; thermo-kinetic surface technologies; bioceramics; nanoceramics; pilot plant size furnaces for sintering, pyrolysis and graphitization; lacquering facility equipped with computer-controlled robot; thermal spraying laboratories fully automizated with computer-controlled robots; facilities for coating of motor blocks and of woven fabrics; carbon fiber coating facility; workstation for FE simulations.

Infrastructures:

Coating Technologies:

- HVOF (High Velocity Oxygen Fuel) coating system TopGun™; fuelled with acetylene, propane, hydrogen and liquid fuel
- APS (Atmospheric Plasma Spray) coating System with F1 and F4 gun; plasma gas: argon, helium, hydrogen and nitrogen
  additional inert gas shroud is possible
- PLC: Siemens S7, process automatisation
- All coating systems mounted on industrial robots
- Lacquer spray chamber with robot and manual airspray
- Several blast cubicles for substrate pre-treatment

Diagnostics
- In-situ diagnostic: infrared online thermography and pyrometry
- On-line rheometry of CIM, MIM and extrusion feedstocks

Systems engineering
- Spray dryer
- Hydraulic press 100t; cold dry and warm pressure molding, computer-controlled
- Injection molding machine, industrial control systems, computer-controlled
- Kneader and double screw extruder

Compounding
- Build up granulation and mixing
- Several mixing tools for intensive mixing of powders and fibres
- Kneading and extrusion compounding

Grinding Tools
- Ball mill
- Bead mill
- Attrition mill, nano powder disperser

High temperature treatment
- High temperature chamber kiln with graphite heating elements up to 2500 °C, 80l packing space
- Special chamber kiln for controlled pyrolysis up to 1100 °C
- Chamber kiln with hydrogen atmosphere
- Chamber kiln for graphitizing
- Tube kiln with controller, vacuum pump and thermostat
- Elevator kiln for oxide ceramics
- Tempering kiln
- Ceramic kiln

Analytic
- Dilatometer
- Rheometer
- Hg-Porosimeter
- BET-Porosimeter and analyzer
- Powder size characterisation
- Zeta master
- Surface roughness measurements
- Dynamic micro hardness measurements 4mN to 1000mN
- Impedance spectroscopy / electrochemical workstation
- Wetting angle and surface energy measurements
- Thermal analysis; DSC, DTA, TG

Metallography

- Thin section preparation
- Image analysis for microscopy
- Light microscopy, polarised light microscopy
- PLOTA texture analysis

Materials and Component testing

- Universal testing machine Zwick Z100/TL3A
- Tribometer, pin-on-disc, oscillating and rotating, under controlled-atmosphere
- Microhardness measurement
- 3D coordinate measuring machine
- High Voltage testing device
- Residual stress analysis, micro hole drilling and milling method
- Workstation (SUN) for FEM-simulation method with ABAQUS
- Surface characterization, roughness, topography, wetting behaviour

Key publications:

- **Gadow, R.;** Kern, F.; "Pressureless Sintering of Injection Molded Zirconia Toughened Alumina Nanocomposites". *Journal of the Ceramic Society of Japan*, 114 [11] (2006), The Ceramic Society of Japan, ISSN 0914-5400, pp. 867 – 871.
- **Gadow, R.;** Kern, F.; "Nanostructured carbon and graphite – ultra lightweight engineering materials". *Advances in Science and Technology*, Vol. 45 (2006), Trans Tech Publications Ltd., p. 1495 – 1504.
- **Gadow, R.**; von Niessen, K.; "Lightweight ballsitic and additional stab protection made of thermally sprayed ceramic and cermet coatings on aramide fabrics". *International Journal of Applied Ceramic Technolgy*, 3 [4] (2006), Blackwell Publishing, ed. Dr. Hua-Tay Lin, Print ISSN: 1546-542X, Online ISSN: 1744-7402, p. 284 – 292.
- **Gadow, R.**; Kern, F.; "Continuous liquid phase coating of carbon fibers with ceramic precursors and application in CMC composites". 107th American Ceramic Society Annual Meeting, ACerS, 10. – 13. April 2005, Baltimore.
- **Gadow, R.**; Speicher, M.; "Advanced Manufacturing of Ceramic Matrix Composites for Disk Brake Rotors". *Advances in Lightweight Materials for Automotive Applications,* Society of Automotive Engineers, SAE International, Inc., 400 Commonwealth Drive, Warrendale, PA 15096 - 001, USA (2003), ISBN 0-7680-1156-6, SAE / SP – 1735, Technical paper 2003-01-1178, pp. 127 – 137.
- Friedrich, C.; **Gadow, R.;** Killinger, A.; "Plasma Sprayed Dielectric and Ceramic Coatings for Ozonizer Tubes". *Proceedings of EUROMAT 99*, Symposium G4; EUROMAT 99, 27.-30. Sept. 1999, Neue Messe München.
- Friedrich, C.; Killinger, A.; **Gadow, R.;** "Atmospheric Plasma Sprayed Dielectric and Ceramic Coatings for Ozonizer Tubes". *Ceramic Transactions,* Vol. 106, Electronic Ceramic Materials and Devices, eds. K. m: Nair and A. S. Bhalla, The American Ceramic Society, Westerville Ohio, 1999, ISBN 0-944904-77-7, pp. 527 – 540.
- **Gadow, R.**; "Ceramic layer composites in advanced automotive engineering, biomedical applications and environmental technologies". *Key Engineering Materials*, Vol. 333, Layered, Functional Gradient Ceramics, and Thermal Barriers, eds. M. Anglada, E. Jiménez-Piqué and P. Hvizdoš, Trans Tech Publications Ltd., ISBN 0-87849-424-3, p. 177 – 194.
- **Gadow, R.;** Baccalaro, M.; von Niessen, K.; "Bioceramic coatings and composites for implant and prostheses in modern surgery". *Proceedings of 9th European Interregional Conference on Ceramics, CIEC9*,

September 5-7, 2004, Bardonecchia, Italy, ISBN 88-8202-010-X, Nuova Ripografica, Torino, Italy, Hrsgb. Politecnico di Torino, 2004, pp. 357 – 362.

- Baccalaro, M.; **Gadow, R.**; von Niessen, K.; "Thermally sprayed tricalcium phosphate (TCP) coatings on polylactide products for biomedical implants". EUROMAT 2003, European Congress on Advanced Materials and Processes, 1.-5. September 2003, Lausanne, Schweiz.
- Baccalaro, M.; **Gadow**, **R.**; von Niessen, K.; "Atmospheric plasma spraying (APS) of graded multilayer titanium dioxide / calciumphosphate coatings on titanium for biomedical implants". *Ti-2003 Science and Technology*, ed. G. Luetjering, J. Albrecht, Wiley Verlag (2004), ISBN: 3-527-30306-5, 3345 – 3353.
- Eckert, K.-L.; Groscurth, P.; **Gadow, R.**; Wintermantel, E.; "Implantable ceramic cell carriers for liver cell transplantation". *Advanced Ceramics and Composites=Neue keramische Werkstoffe und Verbundwerkstoffe/6th Interregional European Colloquium on Ceramics and Composites*, Rainer Gadow (ed.), Expert-Verlag, Renningen-Malmsheim (2000), ISBN 3-8169-1830-1, pp. 66 – 70.
- Fischer, R.; **Gadow, R.**; "Processing and component development of aluminum nitride heat exchangers". *Advances in Powder Metallurgy and Particulate Materials*, MPIF, Metal Powder Industries Federation, Princeton, New Jersey, 2000, ISBN 1-878954-78-4, pp. 4 / 45 – 4 / 54.
- **Gadow, R.**; Schirmer, T.; "Proton conducting ceramic membranes for direct methanol fuel cell applications". 7th International Symposium "*Ceramic Materials and Components for Engines*", June 19 – 21, 2000, Goslar, DKG, oral presentation.
- **Gadow, R.**; Scherer, D.; Stahr, C.C.; "Advanced functional and protective coatings for magnesium components in automotive applications". *Proceedings of the International Conference Advanced Metallic Materials*, 5. - 7.11.2003, Smolenice, Slowakei eds. J. Jerz; P. Sebo; M. Zemankova, (2003), ISBN 80-969011-7-6, 97 – 100.
- Friedrich, C.; **Gadow, R.**; Killinger, A., Li, C.; Wermbter, K.; "Ceramic Cooktop". US Patent Nr. US 6,921,882 B2, Date: 26.06.2005, Filed: 25.08.2003, Prior Publication Data: US 2004/0112886 A1, 17.06.2004, Assignee: Schott AG, Mainz (DE).
- **Gadow, R.**; Haug T.; Kienzle A.; Weißkopf K.; Tielmann; et al.; "Melted – infiltrated fiber - reinforced composite ceramic". US Patent Nr. US 6,793,873 B2, Date: 21.09.2004, Filed: 23.08.2001, Prior Publication Data: US 2002/0142146 A1, 03.10.2002, Assignee: DaimlerChrysler AG, Stuttgart (DE).
- Friedrich, C.; **Gadow, R.**; Killinger, A.; Li, C.; Wermbter, K.; "Ceranfeld mit Haftvermittlerschicht". Internationales Patent Nr. WO 02/071801 A1, AT: 19.02.2002, Internationales Veröffentlichungsdatum: 12.09.2002, Internationale Aktenzeichen: PCT/EP02/01742, Priorität: DE 10112236, 06.03.2001.
- Friedrich, C.; **Gadow, R.**; Günther, S.; Killinger, A.; Riege, G.; "Ozonisator und Verfahren zur Herstellung eines solchen". Deutsches Patent Nr.: DE 198 22 841 B4, Anmeldetag: 22.05.1998, Offenlegungstag: 22.11.1999, Veröffentlichungstag der Patenterteilung: 12.01.2006.

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2. Past and present research collaborations

Are you familiar with the European Framework Programme?	☒ **Yes** ☐ **No** ☐ with Framework Programme 5 ☒ with Framework Programme 6 ☒ with Framework Programme 7
EU-projects you are involved in: **Past projects**	**Programme title / contract number / title / acronym / your function (coordinator / partner / contractor)**
Present projects	Sixth Framework Programme / NMP3-CT-2005-515784 / Structural Ceramic Nanocomposites for top-end Functional Applications / IP Nanoker / Coordinator
Other international collaborations:	**Selected collaboration partners…** **France** • École Nationale Supérieure de Chimie, Lille • Institut National de Sciences Apliquées de Lyon (INSA) **Great Britain** • University of Wales Swansea, Dept. of Mechanical Engineering • University of Leeds, School of Mechanical Engineering **Italy** • Politecnico di Torino, Dipartimento di Scienza dei Materiali e Ingegeneria Chimica • Università degli Studi di Roma “La Sapienza”, Dipartimento di Ingegneria Chimica, di Materialia, delle Materie Prime e Metallurgia **Japan** • Chuo University, The Institute of Science and Technology, Tokyo • Osaka National Research Institute (ONRI), Osaka • Tokyo Institute of Technology, Yokohama **Russia** • Russian Academy of Sciences, A.A. Baikov Institute of Metallurgy, Moscow **Turkey** • Kocaeli University, Dept. of Metallurgical and Materials Engineering • TÜBITAK-MRC, Gebze **USA** • NASA Glenn Research Center, Ceramics Branch, Cleveland, OH • State University of New York at Stony Brook, NY • Massachusetts Institute of Technology, Cambridge, MA
Name(s) and contact details of potential partners:	**If you would like to suggest the participation of particular partners from the partner country based on existing contacts or collaboration experience, you are welcome to indicate their names and contact details below:** **Prof. Dr. Şadi Karagöz** Head of Department Kocaeli University, Department of Metallurgical and Materials Engineering Veziroglu Campus, Izmit, TR-41040 Kocaeli, Turkey Tel: ++90 (262) 335 3658, Fax: ++90 (262) 335 5486, E-Mail: karagoez@kou.edu.tr

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3. Presentation at the Workshop

I will give a presentation at the workshop (approx. 10 min.) to present my institution, my expertise, and my collaboration interests. The contents of my presentations is summarised below (max. 1 page).

The Institute for Manufacturing Technologies of Ceramic Components and Composites at the University of Stuttgart is part of the faculty of mechanical and manufacturing engineering. The institute is focussed on research topics in manufacturing techniques for ceramic components and composites as well as in materials technology. The main research scope is the interaction between modern material science, process engineering, manufacturing technologies and product development with new materials and processes.

Beside the development of economically efficient and ecologically advanced new material systems for various industries also new methods in material design and production engineering including process automation are investigated and evaluated.

The application of new materials for innovative environmental techniques is a further key account within the institute and is supported by different national and international research projects. The research area of the institute is subdivided in 4 topics:

- Structural Ceramics and Fiber Reinforced Composites
- Functional Ceramics and Fine Powder Technologies
- Surface Technologies and Layer Composites
- Materials Mechanics, Modelling and Simulation

IFKB will be involved to international projects in the future with the long term experiences of 20 scientists in the fields mentioned above. Competence in product and customer oriented manufacturing technology and total quality management (TQM) are key features of the institute. Scientific cooperation with academic co-workers, institutes and the industry in Germany and abroad such as memberships of the Deutsche Keramische Gesellschaft, the Arbeitskreis Kohlenstoff of the DKG e.V., the Deutsche Gesellschaft für Materialkunde, the Deutsche Bundesstiftung Umwelt, the American Ceramic Society, the American Thermal Spray Society, the EPMA as well as APMI, the SAE and many other institutions reflect the position of the institute on the related working areas.

I agree with the publication of my data on the Workshop website!

PLEASE FILL IN THIS FORM UNTIL 22 SEPT. 2006 AND RETURN IT TO:

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