MAPEX Bremen
Material. Process. Excellence.

03
10-2016

SCIENCE & PROJECTS
Large-Scale Research Projects

Universität Bremen

II RUNNING COORDINATED DFG PROJECTS

In the past years, the University of Bremen and the cooperating external institutes located on the university campus have established themselves as a world-leading group of researchers in the field of materials-oriented development of processes, and at the same time of process-oriented development of materials, with a special focus on metals, nanoparticulate materials, carbonreinforced composites, semiconductors, and porous ceramics. The close connection between achieving novel properties and establishing innovative processing routes in materials engineering, making use of chemical/physical analyses and investigation methods, concurrently with mathematical and physical modelling at multiple scales, is best exemplified by the ten running coordinated DFG projects.

Collaborative Research Centers (SFB)

- SFB 747: Micro Cold Forming
- SFB TR 136: Process Signatures
- SFB 1232: Farbige Zustände (newsletter 02)

Research Units

- FOR 1224: Schwarz-Silber (newsletter 04)
- FOR 1845: Ultra-Precision High Performance Cutting (newsletter 04)
- FOR 2213: Nanoporous gold

Priority Program

- SPP 1676: Dry Metal Forming (newsletter 04)

Research Training Groups

- GRK 1860: MIMENIMA (newsletter 04)
- GRK 2247: Quantum Mechanical Materials Modelling – QM³ (newsletter 02-2016)
- GRK 2224: π^3: Parameter Identification – Analysis, Algorithms, Implementations (newsletter 02)

II RESEARCH UNIT 2213: NANOPOROUS GOLD - A PROTOTYPE FOR A RATIONAL DESIGN OF CATALYSTS

NAGOCAT FOR 2213

Nanoporous gold is a relatively new catalyst with great potential in heterogeneous gas and liquid phase catalysis and electrocatalysis. It is a sponge-like material with ligaments and pores in the range of a few 10 nm. Its catalytic properties are influenced by traces of a second metal and the nanostructure. The DFG research unit NaGoCat aims at elucidating these factors on different length scales from the atomistic level (active sites for adsorption and reaction) up to the mesoscopic level (transport of the reactants by diffusion).

This interdisciplinary effort is only possible by bringing together the expertise of eight groups from four different universities in northern Germany (Oldenburg, Bremen, Hamburg-Harburg, Berlin), contributing experimental as well as theoretical expertise in chemistry, materials sciences, and physics. Three areas are covered in the unit: material preparation and characterization, gas phase catalysis and liquid phase catalysis/electrocatalysis. Bringing together basic insight from theory and fundamental research as well as experiments on nanoporous gold under ambient/working conditions, the unit aims at exploring its catalytic properties with special attention to the impact of varying chemical and structural features of the surface as well as the scale and geometry of the pores on the activity and selectivity for the oxidation of primary alcohols, an industrially relevant reaction.

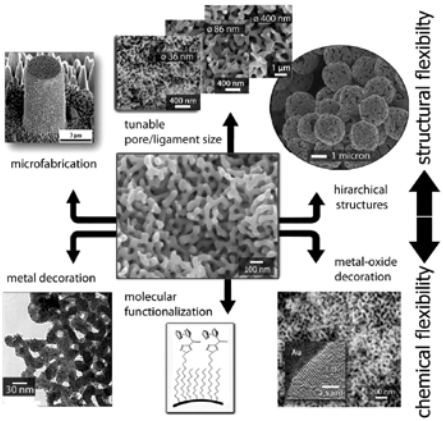
Research Unit 2213: Nanoporous gold - A prototype for a rational design of catalysts

Funding: 2014 –

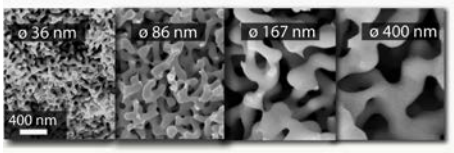
Speaker: Marcus Bäumer

Subproject leaders from MAPEX: Marcus Bäumer, Andreas Rosenauer and Arne Wittstock

Website: www.nagocat.uni-bremen.de



Nanoporous gold as a flexible functional material (Reproduced/Adapted from Wittstock et al., Nanoporous Gold: from an Ancient Technology to a Novel Material, RSC, 2012, p. 250).



Coarsening of the pore structure of npAu upon annealing (note similar scale bars).

COLLABORATIVE RESEARCH CENTER 747: MICRO COLD FORMING - PROCESSES, CHARACTERIZATION, OPTIMIZATION

The Collaborative Research Center 747 „micro cold forming“ (German: Sonderforschungs-bereich 747 “Mikrokaltumformen”) is a 12 year long basic research project financed by the Deutsche Forschungsgemeinschaft. It is located at University of Bremen since 2007.

Aim of the SFB 747

Central concern of the Collaborative Research Center is the provision of methods and processes for a systematic design of reliable micro cold forming processes with focus on its implementation in industrial applications of metallic micro components produced with lot sizes greater than one million pieces.

Expertise areas of the SFB 747

An effective treatment of technical issues of micro metal forming requires an accurate consideration of basic material properties, their modifications owing to controlled process impacts, the resulting component properties and process design. Approximately 70 scientists and technicians from the disciplines of engineering, physics, materials science, and mathematics rise to these challenges in the expertise areas micro forming processes, tools, materials, properties and process design.

Industry network

During its activities the Research Center is attended by a network of industry partners, which is regularly informed about the most recent results. Mutual exchange within the network as in the annual meeting provides a basis for corporate projects aiming at a transfer of scientific achievements into industrial applications.

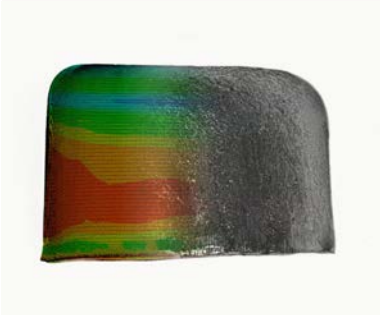
Collaborative Research Center 747:
Micro Cold Forming - Processes, Characterization, Optimization

Funding: 2007 - 2018

Speaker: Frank Vollertsen; **Vice Speaker:** Peter Maaß; **Administration:** Sybille Friedrich

Subproject leaders from MAPEX:
Ralf B. Bergmann, Ekkard Brinksmeier, Bernd Kuhfuß, Peter Maaß Alfred Schmidt, Kristen Tracht, Frank Vollertsen, Hans-Werner Zoch

Website: www.sfb747.uni-bremen.de



Metallic Microcup superimposed with FEM-Simulation.

II TRANSREGIONAL COLLABORATIVE RESEARCH CENTRE 136: FUNCTION-ORIENTED MANUFACTURING BASED ON CHARACTERISTIC PROCESS SIGNATURES

The generation of well-defined geometrical properties in machining processes is state of the art in industry. This is not true for chemical and physical material properties of the workpiece surface layer. However, these properties are of main importance regarding the functional performance of the part. The reason is that even today a fundamental understanding of the basic mechanisms leading to material alterations in machining processes is still missing. The transregional Collaborative Research Centre 136 (CRC 136) "Process Signatures", a collaboration of the University of Bremen, the RWTH Aachen University, and the Oklahoma State University, established in 2014 is aiming exactly at this knowledge gap.

The work within the transregional CRC 136 focuses on identifying the quantitative dependencies of state variable changes (e.g. residual stresses, phase composition, chemical composition) on the internal material loading state of the workpiece during the manufacturing processes e.g., the time-dependent stress-strain state, temperature field and spatially varying chemical potential. By means of Process Signatures it will be possible to describe manufacturing processes in a unified way for the first time. The long-term objective of the research work is to solve the so-called inverse problem of manufacturing technology: By utilising Process Signatures it will be possible to select the necessary manufacturing processes, the corresponding parameters and the subsequent application of further machining processes based on previously defined chemical and physical material properties of the workpiece surface layer.

Transregional Collaborative Research Centre 136: Function-Oriented Manufacturing Based on Characteristic Process Signatures

Funding: 2014 – 2017 (first funding period)

Speaker: Ekkard Brinksmeier; **Vice Speaker:** Fritz Klocke (RWTH Aachen); **Executive Manager:** Jens Sölter

Subproject leaders from MAPEX: Ekkard Brinksmeier, Carsten Heinzel, Walter Lang, Daniel Meyer, Jens Sölter, Frank Vollertsen, Hans-Werner Zoch

Website: www.prozesssignaturen.de