

Dr. rer. nat. Žaklina Burghard



Research field - bioinspired synthesis and characterization of nanostructured oxide based paper-like composite materials, which mimic the structural design principles of biomaterials. The focus is on development of mechanically stable materials for use as actuators, sensors and electrochemical energy storage.

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Professional background

- since 2006 **Group leader**, Faculty of Chemistry, Institute of Material Science, Chair of Chemical Materials Synthesis, University of Stuttgart, Germany.
Teaching activities, e.g., Exercises Material Science (Master's program); Synthesis and Properties of Ceramic Materials, Materials Science Seminar (Bachelor & Masters course).
- 2004–2006 **Postdoctoral research fellow**, Max Planck Institute for Metals Research Powder Metallurgy Laboratory, Stuttgart, Germany.

Academic Career

- 2001–2004 **Dr. rer. nat., Materials Science**, Faculty of Chemistry, Institute of Materials Science, University of Stuttgart, Germany.
Thesis: Behavior of glasses and polymer derived amorphous ceramics under contact stress.
- 1995–1999 **Magister of Science, Materials Science**, Institute for Construction Materials, Faculty of Technology and Metallurgy, University of Belgrade, Serbia.
Thesis: The influence of SiC particles on the microstructure and mechanical properties of metal matrix composites.
- 1987–1995 **Diploma, Chemical and Biochemical Engineering**, Faculty of Technology and Metallurgy, University of Belgrade, Serbia.
Thesis: Thermodynamic and exergy analysis of condenser with condensation in the pipes.

Research Projects

- 2014–2016 BioMatS-16, Selbstwachsende Nanopiezoaktorik; Ein bioinspirierter Ansatz, Baden-Württemberg Stiftung (BWS).
- 2014–2016 BU 2713/2-1, Synthese und Bestimmung der mechanischen Eigenschaften von aufgerollten Nanokompositen als Modell von Schwammnadeln, Deutsche Forschungsgesellschaft (DFG).
- 2011–2016 BI 469/17, Synthesis and characterization of paper-like, nanostructured electrodes for advanced secondary batteries, DFG.
- 2009–2012 BI 469/15-1, Biologische Erzeugung von Oxidkeramiken; In vivo und in vitro Synthesen von Oxidkeramiken, DFG.
- 2008–2010 BI469/14-2, Nanomechanical characterisation of multilayered organic–inorganic composite films produced by bioinspired processing routes (zweite Projektlaufzeit), DFG.

2006–2008	AL384/37-1, Nanomechanical characterization of multilayered organic-inorganic composite films produced by bioinspired processing routes, DFG.
2005–2008	BI 469/10, Synthesis and property characterization of precursor-derived ceramics reinforced by functionalized single-wall carbon nanotubes, DFG.
2005–2008	I-810-236.10, Ti alloy scaffolds with hierarchical pore structure and tailored mechanical and osteogenic properties using monolayer coatings–immobilized biomolecules, German-Israeli-Foundation (GIF).

Selected Publications

Z. Burghard, A. Leinweber, P. A. Van Aken, et al., Hydrogen bond reinforced vanadia nanofiber paper of high stiffness, *ADVANCED MATERIALS*, 25, 2468, (2013).

M. L. Lemloh, Z. Burghard, J. B. Forien, et al., Low Mg/Ca ratio alters material properties in sea urchin larvae skeleton, *BIOINSPIRED, BIOMIMETIC and NANOBIOMATERIALS*, 2, 28, (2012).

D. Santhiya, Z. Burghard, C. Greiner, et al., Bioinspired Deposition of TiO₂ Thin Films Induced by Hydrophobins, *LANGMUIR*, 26, 6494,(2010).

Z. Burghard, L. Zini, V. Srot, et al., Toughening through nature adapted nanoscale design, *NANO LETTERS*, 9, 4103, (2009).

Z. Burghard, A. Tucic, L.R.H. Jeurgens, et al., Nanomechanical properties of bioinspired organic inorganic composite films, *ADVANCED MATERIALS*, 19, 970, (2007).

Selected Media presence

Internet	American Ceramic Society - Role of hydrogen bonds in extremely flexible vanadium oxide nanofiber paper Materials views (VCH-Wiley) - Tough and pliable: a paper-like ceramic
Magazines	Medizin und Technik 03/13 - Keramik zum Falten Architekturmagazin „Just de_tiles“ (06/13) - Keramikpapier zum Falten Standortmagazin der Region Stuttgart - Keramik zum Knautschen
Interviews	Deutschlandradio (04.06.2013) - Forschung aktuell - Keramik zum Falten Materials Today (05.08.2013) - Podcast: Ceramic Paper

Patents

2012

Z. Burghard, J. Bill, S. Deenan, Process for deposition of thin layers of metal oxides, 20120202068 (2012). Diese Patentanmeldung beinhaltet einen Prozess zur Abscheidung von Metalloxiden (z.B. Titandioxid) in Form einer dünnen Schicht auf einem Substrat, mithilfe eines Biopolymer-Templats, insbesondere eines Hydrophobins. BASF GmbH, Universität Stuttgart, Max Planck Gesellschaft.

Thesis supervision

Master (5), Bachelor (7), Diploma (8), PhD (3).

Professional activity and future visions

As a material scientist, I have been investigating the microscopic structure and the resulting mechanical properties of different biomaterials including nacre, sea urchin spines or sponge spicules. I was able to clarify the relationship between the structure of these materials on the nanometer scale and their mechanical reinforcement mechanisms. By transferring the structural principles optimized by nature into the field of bio-inspired materials synthesis, I successfully prepared for instance nanostructured ceramic papers with a thickness in the micrometer range. Due to their hierarchical architecture, the papers can be bent almost arbitrarily and even folded. At the same time, they display a unique combination of good electrical conductivity and ion intercalation capability.

From my point of view, a major future challenge in materials science is to develop innovative materials for renewable energy. It is my vision to develop and optimize bio-inspired electrode materials for batteries. The aim is to design not only the electrodes, but all battery components that are composed of a flexible, paper-like material, and like in biological structures to fine tune the individual components with respect to each other.