

Professor Jeschke will deliver the 2009 Bruker Lecture at the 42<sup>nd</sup> Annual International Meeting of the ESR Group of the RSC entitled "Measuring the Nanoworld"



Gunnar was born in Cottbus, Germany in 1966 and grew up in the industrial town Schwarzheide midway between Cottbus and Dresden, playing soccer as a goalkeeper and taking part in national mathematics and international chemistry competitions. After four years of military service as an air defence officer, working with X-band radar equipment, he studied chemistry at Technical University of Dresden. In his second term he joined the NMR group of Prof. G. Großmann as a kind of computer programming assistant and wrote his diploma thesis on "Error sources in measurement and analysis of solid-state MAS NMR spectra".<sup>[1]</sup> Hunting errors in measurements and data analysis remained one of his favourite occupations thereafter. After a first application to join Richard Ernst's NMR group at ETH Zurich failed, Gunnar went to Japan for one year with a grant from Studienstiftung des Deutschen Volkes, co-sponsored by the Institute for Physical and Chemical Research, RIKEN, in Wako-shi, near Tokyo. In the group of Prof. S. Hayashi he worked on magnetic field effects during photolysis of aromatic disulfides<sup>[2]</sup> and made first contact with EPR spectroscopy. His second application in Zurich, supported by a Kekulé grant of Fonds der Chemischen Industrie, succeeded. In the group of Prof. A. Schweiger, he worked on his Ph.D. thesis on "New concepts in solid-state pulse electron spin resonance",<sup>[3-5]</sup> which he defended in 1996. In the same year he received the "Young Investigator Award" of the International EPR/ESR Society and one year later the Medal of ETH Zurich for the Ph.D. thesis.

During his first PostDoc, supported by a Liebig grant of Fonds der Chemischen Industrie, Gunnar turned back to solid-state NMR, with an emphasis on MAS NMR of quadrupolar nuclei.<sup>[6,7]</sup> He joined the solid-state chemistry group of Prof. M. Jansen, then at University Bonn, and worked on high performance ceramics containing silicon, boron, nitrogen, and carbon.<sup>[8]</sup> In 1998 he became project leader for EPR spectroscopy in H.W. Spiess's Department of Polymer Spectroscopy at Max Planck Institute for Polymer Research Mainz. He worked on development and application of EPR methods for characterization of structure and dynamics of polymers. Systems of interest were shape-persistent macromolecules in a long-standing collaboration with Prof. A. Godt at Bielefeld University,<sup>[9,10]</sup> polymer dispersions and films made thereof,<sup>[11]</sup> polyelectrolytes,<sup>[12]</sup> and polymer-clay nanocomposites.<sup>[13]</sup> Method development included the improvement of precision, sensitivity and application range of pulse EPR distance measurements,<sup>[14-16]</sup> transformation of dipolar evolution data to distance distributions,<sup>[17,18]</sup> and the measurement of intermolecular interactions between spin probes and neighboring nuclei by ESEEM and ENDOR

techniques.<sup>[19,20]</sup> Between 1998 and 2001 Arthur Schweiger and Gunnar Jeschke exchanged several hundred e-mails. This exchange eventually led to publication of the monograph "Principles of Pulse Electron Paramagnetic Resonance".<sup>[21]</sup> Being mentored by Prof. H. W. Spiess and Prof. H. Sillescu at Johannes Gutenberg University of Mainz, Gunnar finished his habilitation in 2003. He was awarded a stipend of Hermann-Schnell-Stiftung at GDCh in 2001 and a Dozentenstipendium of Fonds der Chemischen Industrie in 2003.

Starting in 2002, Gunnar turned to application of pulse EPR techniques to spin-labeled membrane proteins and published the first pulse EPR distance measurements in this class of biomacromolecules.<sup>[22]</sup> Current projects include the major plant light harvesting complex LHCIIB of green plants in a collaboration with Prof. H. Paulsen at University of Mainz,<sup>[20,23]</sup> and the proline/sodium symporter PutP of *E. coli* in a collaboration with Prof. H. Jung at LMU Munich and Prof. H.-J. Steinhoff at University Osnabrück.<sup>[22,24]</sup> A collaboration with Jung, Steinhoff, and Prof. E. Padan from Hebrew University Jerusalem led to determination of the structural arrangement of the sodium/proton antiporter dimer NhaA of *E. coli*.<sup>[25]</sup>

In 2006 Gunnar took the position of full professor of Physical Chemistry at University of Konstanz and became Secretary General of Groupment AMPERE. In 2008 he was appointed full professor for Electron Spin Resonance at ETH Zurich. His work further focuses on membrane proteins and polymers with side interests in metalloproteins and catalysts. Method development is directed at structural modeling from EPR-derived restraints and new methods for distance measurements and detection of correlations between more than two electron spins. A long-standing collaboration project with Dr. J. Matysik at Leiden University is concerned with solid-state photo-CIDNP MAS NMR on photosynthetic reaction centers.<sup>[26-28]</sup>

### Selected publications:

- [1] G. Jeschke, G. Grossmann, **J. Magn. Reson. A** 103, 323-328 (1993), *Spinning-Sideband-Pattern Deviations in Cross-Polarization MAS NMR*.
- [2] G. Jeschke, M. Wakasa, Y. Sakaguchi, H. Hayashi, **J. Phys. Chem.** 98, 4096 (1994), *Magnetic Field Effects Observed upon Photolysis of Para-Substituted Diphenyl Disulfides in Micellar Solution*.
- [3] G. Jeschke, A. Schweiger, **Chem. Phys. Lett.** 246, 431 (1995), *Hyperfine-correlated electron nuclear double resonance spectroscopy*.
- [4] G. Jeschke, A. Schweiger, **J. Chem. Phys.** 106, 9979-91 (1997), *Hyperfine decoupling in electron spin resonance*.
- [5] G. Jeschke, R. Rakhmatullin, A. Schweiger, **J. Magn. Reson.** 131, 261-71 (1998), *Sensitivity enhancement by matched microwave pulses in one- and two-dimensional electron spin echo envelope modulation spectroscopy*.
- [6] G. Jeschke, **J. Chem. Phys.** 108, 907-17 (1998), *Spin locking of  $I=3/2$  nuclei in static and spinning samples- A description by abstract spins and Floquet formalism*.
- [7] G. Jeschke, M. Jansen, **Angew. Chem. Int. Ed. Engl.** 37, 1282-3 (1998), *High resolution  $^{14}\text{N}$  solid state NMR spectroscopy*.
- [8] G. Jeschke, M. Kroschel, M. Jansen, **J. Non-Cryst. Solids** 260, 216-227 (1999), *A magnetic resonance study on the structure of amorphous networks in the Si-B-N(-C) system*.
- [9] G. Jeschke, A. Godt, **ChemPhysChem** 4, 1328-1334 (2003) *Co-Conformational Distribution of Nanosized [2]Catenanes Determined by Pulse EPR Measurements*.
- [10] A. Godt, M. Schulte, H. Zimmermann, G. Jeschke, **Angew. Chem. Int. Ed.** 45, 7560-7564 (2006), *How flexible are oligo(para-phenyleneethynylene)s?*
- [11] S. E. Cramer, G. Jeschke, H. W. Spiess, **Macromol. Chem. Phys.** 203, 182-191 (2002), *EPR studies on film formation of colloidal dispersions: 1. Site selectivity and techniques*.
- [12] D. Hinderberger, H. W. Spiess, G. Jeschke, **Europhys. Lett.**, 70, 102-108 (2005), *Radial counterion distributions in polyelectrolyte solutions determined by EPR spectroscopy*.
- [13] G. Panek, S. Schleidt, Q. Mao, M. Wolkenhauer, H.W. Spiess, G. Jeschke, **Macromolecules**, 39, 2191-2200 (2006), *Heterogeneity of the Surfactant Layer in Organically Modified Silicates and Polymer/Layered Silicate Composites*.

- [14] G. Jeschke, **Macromol. Rapid. Commun.** 23, 227-246 (2002), *Determination of the Nanostructure of Polymer Materials by Electron Paramagnetic Resonance Spectroscopy.*
- [15] G. Jeschke, H. W. Spiess, **Lect. Notes Phys.** 684, 21-63 (2006), *Distance Measurements in Solid-State NMR and EPR Spectroscopy.*
- [16] G. Jeschke, Ye. Polyhach, **Phys. Chem. Chem. Phys.**, 9, 1895-1910 (2007), *Distance measurements on spin-labelled biomacromolecules by pulsed electron paramagnetic resonance.*
- [17] G. Jeschke, A. Koch, U. Jonas, A. Godt, **J. Magn. Reson.** 155, 72-82 (2002), *Direct Conversion of EPR Dipolar Time Evolution Data to Distance Distributions.*
- [18] G. Jeschke, V. Chechik, P. Ionita, A. Godt, H. Zimmermann, J. Banham, C. R. Timmel, D. Hilger, H. Jung, **Appl. Magn. Reson.** 30, 473-498 (2006), *DeerAnalysis2006 - A Comprehensive Software Package for Analyzing Pulsed ELDOR Data.*
- [19] P. P. Zänker, G. Jeschke, D. Goldfarb, **J. Chem. Phys.** 122, 024515 (2004), *Distance measurements between paramagnetic centers and a planar object by matrix Mims ENDOR.*
- [20] A. Volkov, C. Dockter, T. Bund, H. Paulsen, G. Jeschke, **Biophys. J.**, 96, 1124-1141, *Pulsed EPR determination of water accessibility to spin-labeled amino acid residues in LHCIIB.*
- [21] A. Schweiger and G. Jeschke, *Principles of Pulse Electron Paramagnetic Resonance*, Oxford University Press, Oxford, 2001.
- [22] G. Jeschke, C. Wegener, M. Nietschke, H. Jung, H.-J. Steinhoff, **Biophys. J.** 86, 2551-2557 (2004), *Inter-Residual Distance Determination by Four-Pulse DEER in an Integral Membrane Protein: the Na<sup>+</sup>/Proline Transporter PutP of Escherichia coli.*
- [23] G. Jeschke, A. Bender, T. Schweikardt, G. Panek, H. Decker, H. Paulsen, **J. Biol. Chem.**, 280, 18623-18630 (2005), *Localization of the N-terminal domain in light-harvesting chlorophyll a/b protein (LHCIIb) by electron paramagnetic resonance (EPR) measurements.*
- [24] D. Hilger, Y. Polyhach, H. Jung, G. Jeschke, **Biophys. J.**, 96, 217-225 (2009), *Backbone structure of transmembrane domain IX of the Na<sup>+</sup>/proline transporter PutP of Escherichia coli.*
- [25] D. Hilger, Ye. Polyhach, E. Padan, H. Jung, G. Jeschke, **Biophys. J.**, 93, 3675-3683, (2007), *High-resolution structure of a Na<sup>+</sup>/H<sup>+</sup> antiporter dimer obtained by pulsed EPR distance measurements.*
- [26] G. Jeschke, **J. Am. Chem. Soc.** 120, 4425-9 (1998), *A new mechanism for chemically induced dynamic nuclear polarization in the solid state.*
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- [28] S. Prakash, Alia, P. Gast, H. J. M. de Groot, J. Matysik, G. Jeschke **J. Am. Chem. Soc.** 128, 12794-12799 (2006) *Photo-CIDNP MAS NMR in intact cells of Rhodobacter sphaeroides R26: Molecular and atomic resolution at nanomolar concentration.*