

Oliver Graudejus, Ph.D

Department of Electrical Engineering
Engineering Quadrangle
Princeton University
Princeton, NJ 08540
E-mail: ograudej@princeton.edu

EDUCATION

Ph.D. in Chemistry and Minor in Biology

1992 to 1996 Justus Liebig-Universität Gießen, Germany
Advisor: Prof. B. G. Müller

Diploma in Chemistry

1987 to 1992 Justus Liebig-Universität Gießen, Germany
Advisor: Prof. B. G. Müller

EMPLOYMENT

Arizona State University, Center for Adaptive Neural Systems, Tempe AZ

2008 to present Associate Research Professor/Adjunct

Princeton University, Department of Electrical Engineering, Princeton NJ

2006 to present Research Scholar (Prof. S. Wagner's group) supported by NJCST, NIH, NJCBIR

- Developed a process to reliably fabricate metal interconnects on a silicone elastomer that can be elastically stretched uni-axially by more than 50% while remaining electrically conducting
- Successfully produced fully functional prototypes of stretchable microelectrode arrays (SMEAs) for soft interfaces with neural tissue
- Demonstrated the capability of SMEAs to record and stimulate action potentials of cultured hippocampus slices under bi-axial strain of up to 13% (collaboration with Barclay Morrison's group in Biomedical Engineering at Columbia University)
- Demonstrated that hippocampus slices cultured on SMEAs can be stretched and relaxed together, thus providing a new tool for research on traumatic brain injury (Columbia U collaboration)
- Presented the technology to research and business organizations

Novellus Systems, Inc., San Jose CA

2004 to 2006 Key Account Technologist: PVD and ALD technology

- Managed European customers for Novellus PVD business (Inova platform) for Ta(N) barrier and Cu seed deposition processes
- Demonstrated benefits of ion assisted Atomic Layer Deposition (iALD) technology

2000 to 2004 Key Account Technologist: CVD technology

- Resolved major technical issues, such as gapfill, plasma damage and low DRAM refresh time, associated with the Novellus high density plasma (HDP) CVD deposition process (SPEED platform) for American, Asian and European customers
- Strengthened business position at existing customers and gained new customers
- Improved gapfill and solved particle issues, which resulted in doubling of uptime and repeat orders exceeding \$20 million

1999 to 2000 Process Engineer: CVD technology

- Developed a new CVD-based phosphorus-doped silicon glass (PSG) deposition process for pre-metal dielectric applications
- Characterized and improved process performance by applying various analytical techniques, e.g., Optical Emission Spectroscopy and Infrared Spectroscopy

University of California, Department of Chemistry, Berkeley CA

- 1996 to 1999 Postdoctoral Researcher (Prof. N. Bartlett's group)
- Developed room temperature methods to synthesize novel, moisture and air sensitive fluorides in high oxidation states
 - Solved the crystal structures of synthesized compounds by single crystal and/or powder X-ray diffraction using synchrotron radiation, and applied NMR- and Raman-spectroscopy, and magnetic measurements using a SQUID to study their properties

TEACHING EXPERIENCE

- 2007 *Princeton University, Princeton NJ*
Instructor for Integrated Circuit Fabrication course
- 1999 *University of California, Berkeley CA*
Teaching Assistant for General Chemistry
- 1992 to 1996 *Justus von Liebig Universität Giessen, Germany*
Teaching Assistant and Assistant Instructor for Inorganic Chemistry
Taught privately organized classes in Organic and Inorganic Chemistry
- 1983 to 1985 *Tilemannschule, Limburg, Germany (high school)*
Tutored French to eighth and ninth graders

AWARDS AND HONORS

- 2005 Promotion to Key Account Technologist, Novellus Systems
- 2003 Promotion to Senior Engineer, Novellus Systems
- 2002 Outstanding Performance Award for the resolution of plasma damage issues during CVD of dielectrics in a high density plasma (HDP) reactor, Novellus Systems
- 2002 Outstanding Performance Award for winning the Infineon 300 mm HDP business, Novellus Systems
- 2001 Outstanding Performance Award for the successful development and productization of a HDP based PSG process, Novellus Systems
- 2000 Award for resolving production issues associated with high Phosphorous content in the HDP PSG process, Cypress Semiconductor
- 1996 Alexander von Humboldt Fellowship award
- 1986 Selected for a seminar from the "Stiftung des Deutschen Volkes"
- 1986 Best Chemistry Student Award at high school (Tilemannschule Limburg)
- 1985 Award for outstanding results at the "International Chemistry Olympiad"

PATENTS

Phosphorus-doped silicon dioxide process to customize contact etch profiles; US Patent 7,064,087 issued June 2006

LANGUAGE AND OTHER SKILLS

- Fluent in German, English and French; advanced knowledge in Italian
- Operation of advanced, automated microfabrication processing equipment
- Design and write photomasks using L-edit and a Heidelberg Laserwriter
- Operation of FEI XL30 SEM
- Software to determine crystal structures from X-ray (Shell) and Synchrotron (Rietveld Method) radiation diffraction data
- Minor in Biology
- Application of microelectrodes for *in vivo* and *in vitro* recording of neural activity

SPECIALIZED TRAINING

Neuroscience

- *Neuroscience Laboratory Course (MOL548)*, Princeton University, Spring 2008
- *Implantable Neuroprosthetics: Technologies and Techniques* - Center for Neural Communication Technology at the University of Michigan, June 2007

Microfabrication

- *'Introduction to Microfabrication' lab course* - Princeton University, Department of Electrical Engineering, June 2006
- *Advanced Silicon Processing* - Stanley Wolf, Moshe Prell, Anthony Lochtefeld, May 2005
- *Silicon Processing for the VLSI Era* - Stanley Wolf, Moshe Prell, Jerry Healey, Simon A. Prussin, Robert B. Simonton, March 2001
- *Process Integration for Submicron IC Technologies* - Stanley Wolf, Jerry Healey, Nick Kepler, Robert B. Simonton, March 2000
- *Novellus Concept Two: SPEED Process Module Maintenance* - Novellus Systems Inc., January 2000
- *Novellus Concept Two: System Operations* - Novellus Systems Inc., October 1999

Methods

- *Design of Experiment (DoE)* - Novellus Systems, March 2002
- *Rietveld Method Short Course* - Angus Wilkinson, June 1999

ONGOING RESEARCH SUPPORT APPLICATIONS SUBMITTED

1. *Sensing Mechanical Manipulations: Calcium Signaling Pathways*, University of Medicine and Dentistry of New Jersey (UMDNJ), Co-PI
2. *Uric acid prevention of post-traumatic brain cell death on stretchable electrodes*, New Jersey Commission on Brain Injury Research (NJBIR), Associate Research Scholar

MANUSCRIPTS FROM RESEARCH ON ELASTICALLY STRETCHABLE MICROELECTRODE ARRAYS

1. Z. Yu, **O. Graudejus**, C. Tsay, S. P. Lacour, S. Wagner, B. Morrison, *Monitoring Electrical Activity from Hippocampal Tissue in Vitro on an Elastically Deformable Microelectrode Array*. Manuscript submitted. Describes the application of stretchable microelectrodes in *in vitro* research on traumatic brain injury.
2. **O. Graudejus**, Z. Yu, J. Jones, B. Morrison III, S. Wagner, *Stretchable Microelectrodes for Recording Spontaneous and Stimulated Activity of Hippocampus Slices under Biaxial Strain*. Manuscript in preparation. Describes details of the fabrication process of stretchable microelectrode arrays and their characteristics in recording and stimulation of neural activity
3. J. Jones, **O. Graudejus**, C. Tsay, S. P. Lacour, S. Wagner, *Photolithographic Patterning of Stretchable Interconnects on a Silicone Elastomer for Elastically Deformable Electronics*. Manuscript in preparation. Describes how process details of patterning microelectrodes affect their stretchability.

REFEREED CONFERENCE PUBLICATIONS

1. **O. Graudejus**, C. Tsay, Z. Yu, B. Morrison, S. P. Lacour, S. Wagner: *Advances in Encapsulating Elastically Stretchable Microelectrode Arrays*, Materials Research Society Symposium Proceedings, Vol. 1009E, U04.2 (2007)
2. C. Tsay, **O. Graudejus**, S. Wagner, S. P. Lacour, B. Morrison: *Morphology and Stretchability of Thin Film Metal Conductors on Elastomeric Substrates*, Materials Research Society Symposium Proceedings, Vol. 1009E, U06.3-03 (2007)

REFEREED JOURNAL PUBLICATIONS

1. H. Fitz, B. G. Müller, **O. Graudejus**, *Über komplexe Fluoride der Iridiumgruppe Li_xMF_6 ($x=1,2$) mit einem Anhang über K_2IrF_6 (On Complex Fluorides of the Iridium Group Li_xMF_6 ($x=1,2$) with an Appendix on K_2IrF_6)*, Zeitschrift für anorganische und allgemeine Chemie 2002, 628, 133-137
2. **O. Graudejus**, A. P. Wilkinson, N. Bartlett, *Structural Features of $Ag[AuF_4]$ and $Ag[AuF_6]$ and the Structural Relationship of $Ag[AgF_4]_2$ and $Au[AuF_4]_2$ to $Ag[AuF_4]_2$* , Inorganic Chemistry 2000, 39, 1545-1548

- O. Graudejus**, A. P. Wilkinson, L. C. Chacón, N. Bartlett, *M-F Interatomic Distances and Effective Volumes of Second and Third Transition Series MF_6^- and MF_6^{2-} Anions*, *Inorganic Chemistry* 2000, 39, 2794-2800
- L. Graham, **O. Graudejus**, N.K. Jha, N. Bartlett, *Concerning the Nature of $XePtF_6$* , *Coordination Chemistry Reviews* 2000, 197, 321-334
- C. Shen, B. Zemva, G.M. Lucier, **O. Graudejus**, J.A. Allman, N. Bartlett, *Disproportionation of Ag(II) to Ag(I) and Ag(III) in Fluoride Systems and the Synthesis and Structure of $(AgF^+)_2AgF_4^-MF_6^-$ Salts ($M=As, Sb, Pt, Au, Ru$)*, *Inorganic Chemistry* 1999, 38, 4570-4577
- O. Graudejus**, S.H. Elder, G. M. Lucier, C. Shen, N. Bartlett, *Room Temperature Synthesis of AuF_6^- and PtF_6^- Salts, $Ag^+AuF_6^-$, $Ag^{2+}PtF_6^{2-}$ and $Ag^{2+}PdF_6^{2-}$, and an Estimate for $E(MF_6^-)$ $M=Pt$ and Pd* , *Inorganic Chemistry* 1999, 38, 2503-2509
- H. Wang, P. Ge, C. G. Riordan, S. Brooker, C. G. Woomer, T. Collins, C. A. Melendres, **O. Graudejus**, N. Bartlett, S. P. Cramer, *Integrated X-ray L Absorption Spectra. Counting Holes in Ni Complexes*, *The Journal of Physical Chemistry B* 1998, 102, 8343-8346
- O. Graudejus**, B. G. Müller, *Zur Kenntnis von $NiPtF_6$ und $CdPtF_6$ (On $NiPtF_6$ and $CdPtF_6$)*, *Zeitschrift für anorganische und allgemeine Chemie* 1996, 622, 1711-1714
- O. Graudejus**, B. G. Müller, *Neue Fluoride $M^{III}M^{IV}F_7$ mit $M^{III}=SE, Tl$ und $M^{IV}=Sn, Pb, Pt$ (New Fluorides $M^{III}M^{IV}F_7$ with $M^{III}=SE, Tl$ and $M^{IV}=Sn, Pb, Pt$)*, *Zeitschrift für anorganische und allgemeine Chemie* 1996, 622, 1601-1608
- O. Graudejus**, B. G. Müller, *Ag^{2+} in trigonal-bipyramidal Umgebung: Neue Fluoride mit zweiwertigem Silber: $AgM_3^{II}M_3^{IV}F_{20}$ ($M^{II}=Cd, Ca, Hg; M^{IV}=Zr, Hf$) (Ag^{2+} in Trigonal-Bipyramidal Environment: New Fluorides with Bivalent Silver: $AgM_3^{II}M_3^{IV}F_{20}$ ($M^{II}=Cd, Ca, Hg; M^{IV}=Zr, Hf$))*, *Zeitschrift für anorganische und allgemeine Chemie* 1996, 622, 1549-1556
- O. Graudejus**, B. G. Müller, *Zur Kristallstruktur von $O_2^+MF_6^-$ ($M=Sb, Ru, Pt, Au$) (On the Crystal Structure of $O_2^+MF_6^-$ ($M=Sb, Ru, Pt, Au$))*, *Zeitschrift für anorganische und allgemeine Chemie* 1996, 622, 1076-1082
- O. Graudejus**, B. G. Müller, *Zur Kristallstruktur von $La[AuF_4]_3$, dem Anfangsglied der Reihe $M[AuF_4]_{3-x}F_x$ ($x=0, 0,5$ und 1) (On the Crystal Structure of $La[AuF_4]_3$, the First Member of the Series $M[AuF_4]_{3-x}F_x$ ($x=0, 0,5$ und 1))*, *Zeitschrift für anorganische und allgemeine Chemie* 1996, 622, 187-190
- O. Graudejus**, F. Schrötter, B. G. Müller, R. Hoppe, *Zur Kristallstruktur von $SmZrF_7$ mit einem Anhang über $EuSnF_7$ und $YSnF_7$ (On the Crystal Structure of $SmZrF_7$ Including an Appendix on $EuSnF_7$ and $YSnF_7$)*, *Zeitschrift für anorganische und allgemeine Chemie* 1994, 620, 827-832

INVITED TALKS AND PRESENTATIONS (2007 TO PRESENT)

- Stretchable Microelectrodes as Novel Neural Interfaces*, University of Louisville, Kentucky, January 2008
- Stretchable Microelectrodes for Biomedical Applications*, Colby College, Maine, December 2007
- Flexible, Stretchable and Conformal Neural Interfaces for Neural Stimulation and Recording*, Jacobs University, Germany, November 2007
- Encapsulating and Patterning Elastic Thin Film Interconnects*, PRISM/PCCM University-Industry Research Symposium, Princeton University, New Jersey, March 2007
- Stretchable Microelectrode Arrays – Application and Fabrication*, Johnson&Johnson Center for Biomaterials and Advanced Technologies (CBAT), Somerville, New Jersey, March 2007
- Flexible Electronic Surfaces for Biomedical Applications*, Innovation Forum, Princeton University, New Jersey, February 2007

CONFERENCE PRESENTATIONS (2007 TO PRESENT)

- Improving the Adhesion of Photopatternable Silicone on Poly Dimethyl Siloxane (PDMS) to Encapsulate Elastically Stretchable Microelectrode Arrays*, O. Graudejus, J. Jones, S. Wagner, The Symposium on Polymers for Microelectronics, Wilmington, May 2008
- Application of Photopatternable Silicone to Encapsulate Elastically Stretchable Microelectrode Arrays: Benefits and Issues*, **O. Graudejus**, J. Jones, Z. Yu, B. Morrison, S. Wagner, Symposium M

- 4.2, Materials and Technology for Flexible, Conformable, and Stretchable Sensors and Transistors, MRS, San Francisco, April 2008
3. *Electrical Conductance of Narrow, Stretchable Interconnects on Elastomeric Substrates with Randomly Nano-patterned Surfaces*, J. Jones, C. Tsay, **O. Graudejus**, P. Mandlik, S. Wagner, Symposium N6.7, Materials and Processes for Advanced Interconnects for Microelectronics, MRS, San Francisco, April 2008
 4. *Stretchable Microelectrode Arrays: Stimulating and Recording Neural Activity During Deformation*, Z. Yu, **O. Graudejus**, C. Tsay, S. P. Lacour, S. Wagner, B. Morrison, Symposium M 12.3, Materials and Technology for Flexible, Conformable, and Stretchable Sensors and Transistors, MRS, San Francisco, April 2008
 5. *Growth of Dissociated Spinal Cord Cultures on Stretchable Microelectrode Arrays*, I. Hu, **O. Graudejus**, J. Jones, M. Kutzing, B. Firestein, S. Wagner, Symposium M 15.1, Materials and Technology for Flexible, Conformable, and Stretchable Sensors and Transistors, MRS, San Francisco, April 2008
 6. *Improving the Resolution of the Encapsulation Process for Elastically Stretchable Thin Film Interconnects*, **O. Graudejus**, J. Jones, I. Hu, S. Wagner, USDC, Flexible Electronics and Displays Conference, Phoenix, January 2008
 7. *Stretchable Microelectrode Array-Based in vitro Platform for the Study of Traumatic Brain Injury*; Z. Yu, **O. Graudejus**, C. Tsay, S. P. Lacour, S. Wagner, B. Morrison III, Neuroscience, program # 261.5, San Diego, 2007
 8. *Stretchable Microelectrode Array: A Potential Tool for Monitoring Neuroelectrical Activity During Brain Tissue Deformation*; Z. Yu, **O. Graudejus**, C. Tsay, S. P. Lacour, S. Wagner, B. Morrison III, 25th Annual National Neurotrauma Society Symposium, poster # 200, Kansas City, July 2007
 9. *Flexible Electronic Surfaces for Biomedical Applications*, **O. Graudejus**, C. Tsay, S. Wagner, New Jersey Commission for Spinal Cord Research, Camden, April 2007
 10. *Advances In Encapsulating Elastically Stretchable Microelectrode Arrays*, **O. Graudejus**, C. Tsay, Z. Yu, B. Morrison, S. P. Lacour, S. Wagner, Symposium U4.2, Advanced Materials for Neuroprosthetic Interfaces, MRS, San Francisco, April 2007
 11. *Morphology and Stretchability of Thin Film Metal Conductors on Elastomeric Substrates*, C. Tsay, **O. Graudejus**, S. Wagner, S. P. Lacour, B. Morrison, Symposium U6.3, Advanced Materials for Neuroprosthetic Interfaces, MRS, San Francisco, April 2007
 12. *Stretchable Microelectrode Arrays: Potential for a Highly Compliant Neural Interface*, Z. Yu, **O. Graudejus**, C. Tsay, S. P. Lacour, S. Wagner, B. Morrison, Symposium U9.2, Advanced Materials for Neuroprosthetic Interfaces, MRS, San Francisco, April 2007
 13. *Stretchable Interconnects for Microelectronics*, J. Jones, S. P. Lacour, **O. Graudejus**, P. Mandlik, S. Wagner, Symposium B5.4, Materials, Processes, Integration and Reliability in Advanced Interconnects for Micro- and Nanoelectronics, MRS, San Francisco, April 2007
 14. *Encapsulating and Patterning Elastic Thin Film Interconnects*, **O. Graudejus**, C. Tsay, S. Wagner, USDC, Flexible Electronics and Displays Conference, Phoenix, February 2007