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EMPLOYMENT

Professor of Physics — **1998-Present**
ARIZONA STATE UNIVERSITY — TEMPE, AZ

Associate Professor of Physics — **1992-1998**
ARIZONA STATE UNIVERSITY — TEMPE, AZ

Contractor — **1997**
MOTOROLA, INC — MESA, AZ

Assistant Professor of Physics — **1987-1992**
ARIZONA STATE UNIVERSITY — TEMPE, AZ

Consultant — **1988-1989**
AT&T BELL LABORATORIES — TEMPE, AZ

Postdoctoral Member of Technical Staff — **1985-1987**
AT&T BELL LABORATORIES — MURRAY HILL, NJ

Research Associate — **1981-1985**
MAX-PLANCK-INSTITUT FÜR FESTKÖRPERFORSCHUNG — STUTTGART, GERMANY

EDUCATION

Dr. rer. nat. — **1985**
UNIVERSITÄT STUTTGART — STUTTGART, GERMANY

Major: Physics
Thesis: Ramanspektroscopische Untersuchungen der Phonon-Phonon und Elektron-Phonon Wechselwirkungen in tetraedisch koordinierten Halbleitern (Raman Investigations of the phonon-phonon and electron-phonon interactions in tetrahedral semiconductors).
Advisor: Prof. Dr. Dr. h.c. Manuel Cardona i Castro.

Licenciado — **1980**
INSTITUTO BALSEIRO — BARILOCHE, ARGENTINA

Major: Physics
Thesis: Espectroscopía de electrones en cerio metálico (Electron Spectroscopy in metallic Cerium)
Advisor: Prof. Dr. Raúl Baragiola

MEMBERSHIPS

American Physical Society. Materials Research Society.
Elected Member-at-Large for the Forum on International Physics (APS) for 1999-2001.
Editorial Board, Applied Physics Letters (2014- 2015)
Editorial Board, Journal of Applied Physics (2015-)

HONORS

1990 Presidential Young Investigator Award
1998 Iberdrola Fellow (Universidad Autónoma de Madrid, Madrid, Spain)
2002 Dean's Quality of Teaching Award, College of Liberal Arts and Sciences, ASU.
2003 Focus Center Fellow, University of Michigan, Ann Arbor.
2008 American Physical Society Outstanding Referee.
2009 Outstanding Teaching Award, Department of Physics, ASU.
2010 Faculty Achievement Award for Defining Edge Research, ASU.
2014 Fellow of the American Physical Society (DMP).

CITATION STATISTICS

Google Scholar: http://scholar.google.com/citations?user=qD-O64UAAAAJ

Researcher ID: http://www.researcherid.com/rid/C-1034-2009

REFEREED JOURNAL PUBLICATIONS

1. C. L. Senaratne, P. M. Wallace, J. D. Gallagher, P. E. Sims, J. Kouvetakis, and J. Menéndez, "Direct gap $Ge_{1-y}Sn_y$ alloys: Fabrication and design of mid-IR photodiodes", J. Appl. Phys. **120** (2), 025701 (2016).
2. C. Xu, J. D. Gallagher, C. L. Senaratne, J. Menéndez, and J. Kouvetakis, "Optical properties of Ge-rich $Ge_{1-x}Si_x$ alloys: Compositional dependence of the lowest direct and indirect gaps", Phys. Rev. B **93** (12) (2016).
3. C. Xu, C. L. Senaratne, J. Kouvetakis, and J. Menéndez, "Experimental doping dependence of the lattice parameter in *n*-type Ge: Identifying the correct theoretical framework by comparison with Si", Phys. Rev. B **93** (4) (2016).
4. J. D. Gallagher, C. L. Senaratne, P. M. Wallace, J. Menéndez, and J. Kouvetakis, "Electroluminescence from $Ge_{1-y}Sn_y$ diodes with degenerate *pn* junctions", Appl. Phys. Lett. **107** (12), 123507 (2015).
5. J. D. Gallagher, C. Xu, C. L. Senaratne, T. Aoki, P. M. Wallace, J. Kouvetakis, and J. Menéndez, "$Ge_{1-x-y}Si_xSn_y$ light emitting diodes on silicon for mid-infrared photonic applications", J. Appl. Phys. **118** (13), 135701 (2015).
6. C. Xu, J. D. Gallagher, P. M. Wallace, C. L. Senaratne, P. Sims, J. Menéndez, and J. Kouvetakis, "*In situ* low temperature As-doping of Ge films using $As(SiH_3)_3$ and $As(GeH_3)_3$: fundamental properties and device prototypes", Semicond. Sci. Technol. **30** (10), 105028 (2015).
7. C. Xu, C. L. Senaratne, J. Kouvetakis, and J. Menéndez, "Compositional dependence of optical

interband transition energies in GeSn and GeSiSn alloys", Solid-State Electronics **110**, 76 (2015).

8. J. D. Gallagher, C. L. Senaratne, C. Xu, P. Sims, T. Aoki, D. J. Smith, J. Menéndez, and J. Kouvetakis, "Non-radiative recombination in $Ge_{1-y}Sn_y$ light emitting diodes: The role of strain relaxation in tuned heterostructure designs", J. Appl. Phys. **117** (24), 245704 (2015).

9. P. Sims, T. Aoki, R. Favaro, P. Wallace, A. White, C. Xu, J. Menendez, and J. Kouvetakis, "Crystalline $(Al_{1-x}B_x)PSi_3$ and $(Al_{1-x}B_x)AsSi_3$Tetrahedral Phases via Reactions of $Al(BH_4)_3$ and $M(SiH_3)_3$ (M = P, As)", Chemistry of Materials **27** (8), 3030 (2015).

10. C. Xu, J. D. Gallagher, P. Sims, D. J. Smith, J. Menéndez, and J. Kouvetakis, "Non-conventional routes to SiGe:P/Si(100) materials and devices based on $-SiH_3$ and $-GeH_3$ derivatives of phosphorus: synthesis, electrical performance and optical behavior", Semicond. Sci. Technol. **30** (4), 045007 (2015).

11. J. D. Gallagher, C. L. Senaratne, P. Sims, T. Aoki, J. Menéndez, and J. Kouvetakis," Electroluminescence from GeSn heterostructure pin diodes at the indirect to direct transition", Appl. Phys. Lett. **106** (9), 091103 (2015).

12. C. Xu, C. L. Senaratne, J. Kouvetakis, and J. Menéndez, "Frustrated incomplete donor ionization in ultra-low resistivity germanium films", Appl. Phys. Lett. **105** (23), 232103 (2014).

13. J. D. Gallagher, C. L. Senaratne, J. Kouvetakis, and J. Menéndez, "Compositional dependence of the bowing parameter for the direct and indirect band gaps in $Ge_{1-y}Sn_y$ alloys", Appl. Phys. Lett. **105** (14), 142102 (2014).

14. L. Jiang, J. D. Gallagher, C. L. Senaratne, T. Aoki, J. Mathews, J. Kouvetakis, and J. Menéndez, Compositional dependence of the direct and indirect band gaps in $Ge_{1-y}Sn_y$ alloys from room temperature photoluminescence: implications for the indirect to direct gap crossover in intrinsic andn-type materials", Semicond. Sci. Technol. **29** (11), 115028 (2014).

15. C. L. Senaratne, J. D. Gallagher, L. Jiang, T. Aoki, D. J. Smith, J. Menéndez, and J. Kouvetakis, "$Ge_{1-y}Sn_y$ (y = 0.01-0.10) alloys on Ge-buffered Si: Synthesis, microstructure, and optical properties", J. Appl. Phys. **116** (13), 133509 (2014).

16. C. L. Senaratne, J. D. Gallagher, T. Aoki, J. Kouvetakis, and J. Menéndez, "Advances in Light Emission from Group-IV Alloys via Lattice Engineering and n-Type Doping Based on Custom-Designed Chemistries", Chemistry of Materials **26** (20), 6033 (2014).

17. J. Kouvetakis, R. Favaro, G. J. Grzybowski, C. Senaratne, J. Menéndez, and A. V. G. Chizmeshya, "Molecular Strategies for Configurational Sulfur Doping of Group IV Semiconductors Grown on Si(100) Using $S(MH_3)_2$ (M=Si,Ge) Delivery Sources: An Experimental and Theoretical Inquiry", Chemistry of Materials **26** (15), 4447 (2014).

18. L. Jiang, T. Aoki, D. J. Smith, A. V. G. Chizmeshya, J. Meneendez, and J. Kouvetakis, "Nanostructure–Property Control in $AlPSi_3$/Si(100) Semiconductors Using Direct Molecular Assembly: Theory Meets Experiment at the Atomic Level", Chemistry of Materials **26** (14), 4092 (2014).

19. C. Xu, R. T. Beeler, L. Jiang, J. D. Gallagher, R. Favaro, J. Menéndez, and J. Kouvetakis, "Synthesis and optical properties of Sn-rich $Ge_{1-x-y}Si_xSn_y$ materials and devices", Thin Solid Films **557**, 177 (2014).

20. L. Jiang, C. Xu, J. D. Gallagher, R. Favaro, T. Aoki, J. Menéndez, and J. Kouvetakis, "Development of Light Emitting Group IV Ternary Alloys on Si Platforms for Long Wavelength Optoelectronic Applications", Chemistry of Materials **26** (8), 2522 (2014).

21. J. D. Gallagher, C. Xu, L. Jiang, J. Kouvetakis, and J. Menéndez, "Fundamental band gap and direct-indirect crossover in $Ge_{1-x-y}Si_xSn_y$ alloys," Applied Physics Letters **103**, 202104 (2013).

22. C. Xu, R. T. Beeler, L. Jiang, G. Grzybowski, A. V. G. Chizmeshya, J. Menéndez, and J. Kouvetakis, "New strategies for Ge-on-Si materials and devices using non-conventional hydride chemistries: the tetragermane case," Semiconductor Science and Technology **28**, 105001 (2013).

23. C. Xu, L. Jiang, J. Kouvetakis, and J. Menéndez, "Optical properties of $Ge_{1-x-y}Si_xSn_y$ alloys with $y>x$: Direct bandgaps beyond 1550 nm," Applied Physics Letters **103**, 072111 (2013).

24. P. E. Sims, A. V. Chizmeshya, L. Jiang, R. T. Beeler, C. D. Poweleit, J. Gallagher, D.J. Smith, J. Menéndez, and J. Kouvetakis "Rational design of monocrystalline $(InP)_yGe_{5-2y}$/Ge/Si(100) semiconductors: synthesis and optical properties," J. Am. Chem. Soc. **135**, 12388 (2013).

25. L. Jiang, P. E. Sims, G. Grzybowski, R. T. Beeler, A. V. G. Chizmeshya, D. J. Smith, J. Kouvetakis, and J. Menéndez "Nanoscale assembly of silicon-like $[Al(As_{1-x}N_x)]_ySi_{5-2y}$ alloys: Fundamental theoretical and experimental studies of structural and optical properties," Physical Review B **88**, 045208 (2013).

26. R. T. Beeler, J. Gallagher, C. Xu, L. Jiang, C. L. Senaratne, D. J. Smith, J. Menéndez, A.V.G. Chizmeshya, and J. Kouvetakis, "Band Gap-Engineered Group-IV Optoelectronic Semiconductors, Photodiodes and Prototype Photovoltaic Devices," ECS Journal of Solid State Science and Technology, **2**, Q172 (2013).

27. G. Grzybowski, A. V. G. Chizmeshya, C. Senaratne, J. Menéndez, and J. Kouvetakis, "Fundamental experimental and theoretical aspects of high-order Ge-hydride chemistry for versatile low-temperature Ge-based materials fabrication," Journal of Materials Chemistry C, **1**, 5223 (2013).

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32. R. T. Beeler, D. J. Smith, J. Kouvetakis, and J. Menendez, "GeSiSn Photodiodes With 1 eV Optical Gaps Grown on Si(100) and Ge(100) Platforms," Photovoltaics, IEEE Journal of **2**, 434 (2012).

33. G. Grzybowski, T. Watkins, R. T. Beeler, L. Jiang, D. J. Smith, A. V. G. Chizmeshya, J. Kouvetakis, and J. Menéndez, "Synthesis and Properties of Monocrystalline $Al(As_{1-x}P_x)Si_3$ Alloys on Si(100)," Chemistry of Materials **24** (12), 2347 (2012).

34. R. Singh, C. D. Poweleit, E. Dailey, J. Drucker, and J. Menéndez, "Raman scattering characterization of strain in Ge–Si core–shell nanowires," Semicond. Sci. Technol. **27**, 085008 (2012).

35. J. T. Teherani, W. Chern, D. A. Antoniadis, J. L. Hoyt, L. Ruiz, C. D. Poweleit, and J. Menéndez, "Extraction of large valence-band energy offsets and comparison to theoretical

values for strained-Si/strained-Ge type-II heterostructures on relaxed SiGe substrates" Phys. Rev. B **85** (20) (2012).

36. G. Grzybowski, L. Y. Jiang, R. T. Beeler, T. Watkins, A. V. G. Chizmeshya, C. Xu, J. Menéndez, and J. Kouvetakis, "Ultra-Low-Temperature Epitaxy of Ge-based Semiconductors and Optoelectronic Structures on Si(100): Introducing Higher Order Germanes (Ge_3H_8, Ge_4H_{10})" Chemistry of Materials **24** (9), 1619 (2012).

37. T. Watkins, L. Jiang, C. Xu, A. V. G. Chizmeshya, D. J. Smith, J. Menéndez, and J. Kouvetakis, "$(Si)_{5-2y}(AlP)_y$ alloys assembled on Si(100) from Al-P-Si_3 building units" Appl. Phys. Lett. **100** (2), 022101 (2012).

38. T. Watkins, L. Y. Jiang, D. J. Smith, A. V. G. Chizmeshya, J. Menendez, and J. Kouvetakis, "Designer hydride routes to 'Si-Ge'/(Gd, Er)(2)O-3/Si(111) semiconductor-on-insulator heterostructures" Semicond. Sci. Technol. **26** (12) (2011).

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41. R. Singh, E. J. Dailey, J. Drucker, and J. Menéndez, "Raman scattering from Ge-Si core-shell nanowires: Validity of analytical strain models," J. Appl. Phys. **110**, 124305 (2011).

42. S. Bagchi, C. Poweleit, R. Beeler, J. Kouvetakis, and J. Menéndez, "Temperature dependence of the Raman spectrum in $Ge_{1-y}S_y$ and $Ge_{1-x-y}Si_xSn_y$ alloys," Phys. Rev. B **84** 193201 (2011).

43. R. T. Beeler, G. J. Grzybowski, R. Roucka, L. Jiang, J. Mathews, D. J. Smith, J. Menéndez, A. V. G. Chizmeshya, and J. Kouvetakis, "Synthesis and Materials Properties of Sn/P-Doped Ge on Si(100): Photoluminescence and Prototype Devices," Chemistry of Materials **23**, 4480 (2011).

44. T. Watkins, A. V. Chizmeshya, L. Jiang, D. J. Smith, R. T. Beeler, G. Grzybowski, C. D. Poweleit, J. Menendez, and J. Kouvetakis, "Nanosynthesis Routes to New Tetrahedral Crystalline Solids: Silicon-like Si_3AlP" J. Am. Chem. Soc. **133** (40), 16212 (2011).

45. R. Beeler, R. Roucka, A. Chizmeshya, J. Kouvetakis, and J. Menéndez, "Nonlinear structure-composition relationships in the $Ge_{1-y}Sn_y$/Si(100) system" Phys. Rev. B **84** (3) 035204 (2011).

46. R. Roucka, R. Beeler, J. Mathews, M.-Y. Ryu, Y. Kee Yeo, J. Menéndez, and J. Kouvetakis, "Complementary metal-oxide semiconductor-compatible detector materials with enhanced 1550 nm responsivity via Sn-doping of Ge/Si(100)", J. Appl. Phys. **109** (10), 103115 (2011).

47. R. Roucka, J. Mathews, R. T. Beeler, J. Tolle, J. Kouvetakis, and J. Menéndez, "Direct gap electroluminescence from Si/$Ge_{1-y}Sn_y$ p-i-n heterostructure diodes", Appl. Phys. Lett. **98** (6), 061109 (2011).

48. J. Menéndez, R. Singh, and J. Drucker, "Theory of strain effects on the Raman spectrum of Si-Ge core-shell nanowires," Annalen der Physik **523**, 145 (2011).

49. R. Roucka, J. Mathews, C. Weng, R. Beeler, J. Tolle, J. Menendez, and J. Kouvetakis, "High performance near IR photodiodes: Novel chemistry-based approach to Ge and Ge-Sn materials integrated on silicon" IEEE J. Quant. Electron. **47**, 213 (2011).

50. J. Mathews, R. T. Beeler, J. Tolle, C. Xu, R. Roucka, J. Kouvetakis, and J. Menéndez, "Direct-gap photoluminescence with tunable emission wavelength in $Ge_{1-y}Sn_y$ alloys on silicon" Appl. Phys. Lett. **97** (22), 221912 (2010).

51. R. Beeler, J. Mathews, C. Weng, J. Tolle, R. Roucka, A. V. G. Chizmeshya, R. Juday, S. Bagchi, J. Menéndez, and J. Kouvetakis, “Comparative study of InGaAs integration on bulk Ge and virtual Ge/Si(100) substrates for low-cost photovoltaic applications,” Solar Energy Materials and Solar Cells **94** 2362 (2010).

52. J. Kouvetakis, J. Mathews, R. Roucka, A. V. G. Chizmeshya, J. Tolle, and J. Menéndez, “Practical Materials Chemistry Approaches for Tuning Optical and Structural Properties of Group IV Semiconductors and Prototype Photonic Devices” IEEE Photonics J. **2** (6), 924 (2010).

53. J. B. Tice, V. R. D’Costa, G. Grzybowski, A. V. G. Chizmeshya, J. Tolle, J. Menéndez, and J. Kouvetakis, “Synthesis and Optical Properties of Amorphous $Si3N_{4-x}P_x$ Dielectrics and Complementary Insights from *ab Initio* Structural Simulations” Chemistry of Materials **22**, 5296 (2010).

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55. J. Xie, A. V. G. Chizmeshya, J. Tolle, V.R. D’Costa, J. Menéndez, and J. Kouvetakis, "Synthesis, Stability Range, and Fundamental Properties of Si-Ge-Sn Semiconductors Grown Directly on Si(100) and Ge(100) Platforms." Chemistry of Materials **22**, 3779 (2010).

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57. V. R. D'Costa, Y.-Y. Fang, J. Tolle, J. Kouvetakis, and J. Menéndez, "Ternary GeSiSn alloys: New opportunities for strain and band gap engineering using group-IV semiconductors," Thin Solid Films **518**, 2531 (2010).

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59. V. R. D'Costa, Y. Fang, J. Mathews, R. Roucka, J. Tolle, J. Menendez, and J. Kouvetakis, "Sn-alloying as a means of increasing the optical absorption of Ge at the *C*- and *L*-telecommunication bands," Semicond. Sci. Technol. **24**, 115006 (2009).

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63. J. Tolle, R. Roucka, B. Forrest, A. V. G. Chizmeshya, J. Kouvetakis, V. R. D'Costa, C. D. Poweleit, M. Groenert, T. Sato, and J. Menéndez, "Integration of Zn-Cd-Te-Se Semiconductors on Si Platforms via Structurally Designed Cubic Templates Based on Group IV Elements," Chemistry Of Materials **21**, 3143 (2009).

64. J. B. Tice, C. G. Weng, J. Tolle, V. R. D'Costa, R. Singh, J. Menéndez, J. Kouvetakis, and A. V. G. Chizmeshya, "Ether-like Si-Ge hydrides for applications in synthesis of nanostructured semiconductors and dielectrics," Dalton Transactions **34** 6773 (2009).

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electrical, and strain behavior," Appl. Phys. Lett. **95** 081113 (2009).

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