

## **Robert L. Opila**

Professor

Department of Materials Science and Engineering

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### **Research Interests**

Research interests include molecular electronics, role of interfaces in organic light emitting diodes and photovoltaics, thin oxide films, semiconductor surface processing, and high-k and low-k dielectric materials. Performance of materials and interfaces are probed with electron spectroscopies.

### **Education:**

1982 Ph.D., Chemistry, The University of Chicago, Chicago, IL. Advisor: R. Gomer.

1977 M. S., Chemistry, The University of Chicago, Chicago, IL.

1975 B. S., Chemistry, The University of Illinois, Urbana, IL., Departmental Distinction

### **Professional Appointments:**

2018—present. rotator, National Science Foundation, Division of Materials Research

2002 – present, Professor, Dept. Materials Sci. and Eng., University of Delaware

2008 – 2009, Interim Chair, Dept. Materials Science and Eng., University of Delaware

1982 - 2001, Bell Labs, Lucent Technologies, Murray Hill, NJ 07974

1995 - 2001, Technical Manager, Surface Preparation and Interface Reliability Group

1993 - 2001, Distinguished Member of Technical Staff

1982 - 1993, Member of Technical Staff

### **Awards and Honors:**

1. Fulbright Scholar, (2012-2013).
2. Visiting Professor, School of Photovoltaics and Renewable Energy, UNSW, Sydney (2013)
3. Fellow, American Vacuum Society (2000).
4. Research Division Affirmative Action Award (1993).
5. James Franck Fellow, The University of Chicago (1975-1977).
6. Edmund James Scholar, University of Illinois (1971-1975).

**Professional Activities:**

1. Editor, *Applied Surface Science* (impact factor—4. 4)
2. Electrochemical Society, New Technology Committee; Chair, Individual Membership; Chair, Dielectric Science and Technology Committees.
3. American Vacuum Society, chair, Applied Surface Science and Electronic Materials Divisions
4. Chaired US Display Consortium on wet chemical processing.
5. President, Faculty Senate 2015-2016
6. College Promotion and Tenure 2003-2005, 2013 –2016, MSE P&T, 2006-07
7. University Graduate Studies Committee, 2005-2008, Chair 2008 – 2010

**Selected Grants:**

1. “IGERT: Sustainable Energy from Solar Hydrogen,” with Christiana Honsberg, \$3,100,000, 10/01/06-12/31/10
2. “Advanced Nanoscale Thin Film & Bulk Materials Toward Thermoelectric Power Conversion Efficiencies of 30%,” DARPA, with RTI, \$190,284, 04/01/08-03/31/11
3. “MRI: Fabrication of an Inverse Photoemission Spectrometer,” NSF, with Rutgers and Brookhaven, \$189,753, 07/01/04-6/30/07
4. “Toward 50% Efficient Solar Cells,” DARPA, \$200,000, 01/01/06 – 08/30/2008
5. “Quantum Energy and Sustainable Solar Technology,” Energy Research Center, NSF/DOE, \$23,000,000 with Christiana Honsberg, ASU.
6. Have also received support from DuPont, ASM, GE, Lucent, Air Liquide and Ubiquitous Technologies. Co-founder of 510nano and SHIO, LLC.

**Selected Publications** (h-index 42, 8038 Citations, total 308 refereed and proceeding publications):

1. A Iyer, J Hack, D Angel Trujillo, B Tew, J Zide, R Opila, Effects of Co-Solvents on the Performance of PEDOT: PSS Films and Hybrid Photovoltaic Devices. *Applied Sciences* 8, 2052 (2018).
2. X Lin, M Chen, A Janotti, R Opila, In situ XPS study on atomic layer etching of Fe thin film using Cl<sub>2</sub> and acetylacetone. *Journal of Vacuum Science & Technology A* 36, 051401 (2018).
3. M. Chen, J. H. Hack, X. Lin, A. Janotti, R. L. Opila, Electronic Structure Characterization of Hydrogen Terminated n-type Silicon Passivated by Benzoquinone-Methanol Solutions. *Coatings* 8, 108 (2018).
4. J. O. Cross, R. L. Opila, I. W. Boyd, E. N. Kaufmann, Materials characterization and the evolution of materials. *MRS Bulletin* 40, 1019-1034 (2015).

5. L. Wang, H. Li, Chao Shen, Jianshu Han, Peinan Teng, Malcolm Abbott, Anthony Lochtefeld, Robert Opila, Allen Barnett, Photoluminescence analysis of a 16.8% efficient 18  $\mu\text{m}$  silicon solar cell. *International Journal of Emerging Technology and Advanced Engineering*, 5 (No 2), 8 – 14 (2015).

### **Presentations:**

At more than 60 universities and conferences including invited talks at Gordon conferences, national and international meetings.

### **International Talks and Conferences**

#### Conferences Organized

1. 13th European Conference on Applications of Surface and Interface Analysis, ECASIA'09, Antalya, Turkey, 18-23 October 2009, Scientific Program Committee.
2. 1st International Conference on Applied Surface Science (ICASS), Shanghai China, 27-30 July 2015, organizing committee; contributed "Adaption of statistical analysis to variable kinetic energy x-ray photoemission spectroscopy for computational depth profiles," by J. Church, R. L. Opila, and C. Weiland.
3. 30th European Conference on Surface Science, Antalya, Turkey, organizing committee, 31 August – 5 September 2014.

#### Talks

1. First International Congress On Adhesion Science And Technology, Invited paper, "X-ray absorption spectroscopy at buried metal/ polymer interfaces" R.L. Opila, K. Konstadinidis, M.A. Marcus and M. Du, Amsterdam, NL Oct 26 1995
2. 5th International Symposium on Ultraclean Processing of Silicon Surfaces (UCPSS), Ostend, BE, 19 Sept. 2000, contributed, "Evolution of Chemical Oxides into Ultrathin Oxides: A Spectroscopic Characterization," J. Eng, R. Opila, J. M. Rosamilia, B. J. Sapjeta, Y. J. Chabal, T. Boone, and R. Masaitis.
3. Workshop on Surface Science – Porto Alegre, Brazil, March 20-22, 2003, "Photoelectron Spectroscopy Investigation of High- Dielectrics," Robert L. Opila.
4. International Conference on Surfaces, Materials, and Vacuum 2010, Keynote Address, "Role of Surfaces and Surface Analysis in Photovoltaics," Cancun, Mexico, 27 September, 2010. Sociedad Mexicana di Ciencia y Tecnologia de Superices y Materiales.

5. Koç Üniversitesi, Department of Chemistry seminar, 22 November 2012; Bilkent University, Chemistry Department, 18 January 2013; “Role of Surface Chemistry in Photovoltaics” R. L. Opila, F. Fang, L. L. Costello, B. E. McCandless, D. Yang, A. Teplyakov, F. Tian.
6. 10th Kimyasal Fizik Kongresi, Ankara, Turkey 12 October 2012 and 3rd Pakistan-Turkey Chemistry Conference, Bursa, Turkey, 14 September 2012 (both invited), “Silicon/Organic Interfaces: Role of Surface Defects and Their Minimization in Photovoltaics,” R. L. Opila, Dan Yang, L. L. Costello, N. Kotulak, F. Tian, A. Teplyakov.
7. University of New South Wales, Sydney, AU, School of Photovoltaics and Renewable Energy Engineering Seminar, “Role of Surfaces and Their Analysis in Photovoltaics,” 23 March 2013.

#### **Selected Patents:**

1. Process for removing metals from solvents used in the manufacture of semiconductor wafers, Yaw S. Obeng, Robert L. Opila, Ramaswamy S. Raghavan, US Patent 6133158 (2000).
2. Vapor deposition process for making compound films, Anthony Michael Desantolo, Kathleen S. Krisch, Mary Louise Mandich, Robert L. Opila, Marcus Weldon, US Patent 5976623 (2000).
3. Electrical Interconnection by a composite medium, Robert L. Opila, US Patent 5045249 (1991).

#### **Selected Books, Edited (10 total):**

1. Polymer/Inorganic Interfaces, MRS Proceedings Volume 304, Symposium held April 14-16, 1993, San Francisco, CA. Editors, Robert L. Opila, F. James Boerio, A. W. Czanderna
2. Chemical Mechanical Planarization in IC Device Manufacturing IV, ECS Proceedings Volume 2000-26, Symposium held October 23-25, 2000, Phoenix, Arizona. Editors R. L. Opila, C. Reidsma-Simpson, K. B. Sundaram, S. Seal.
3. Proceedings of the Seventh International Symposium on Cleaning Technology in Semiconductor Device Manufacturing, held in September 2001, in San Francisco, California. [In: Proc. - Electrochemical Soc., 2002; 2001-26]. (2002) Editors, Ruzyllo, J.; Hattori, T.; Opila, R. L.; Novak, R.
4. Thin Film Materials, Processes, and Reliability. (Proceedings of the International Symposia held 2-7 September 2001, in San Francisco, California.) [In: Proc. - Electrochem. Soc., 2001; 2001-24]. (2001) Editors, Mathad, G. S.; Engelhardt, M.; Opila, R. L.; Rathore, H. S.; Yang, M..
5. Special Issue: European Conference on Surface Science, editors R. L. Opila and G. Ertas, Applied Surface Science, Volume 354 (2015). doi: 10.1016/j.apsusc.2015.09.045

## Customer Discovery

(2016-18): NSF I-Sites, NSF I-Corps, NYC Regional Innovation Node

## Students

1. Korhan Demirkan PhD Interfaces between Organic Films and Electrodes for OLEDs (graduated 6/2008)
2. Ernest Addo PhD Screen-Printable Doped Self-Aligned Metallization for Solar Cell Fabrication (graduated 6/2004)
3. Anoop Mathew PhD Thin Oxide Films for Magnetic Tunnel Junctions (graduated 6/2008)
4. Lijie Bao PhD  $(\text{La}_2\text{O}_3)_x(\text{Al}_2\text{O}_3)_{1-x}$  Films for High-k Dielectrics (graduated 6/2010)
5. Conan Weiland PhD Molecular Electronics on Si(111) (graduated 6/2010)
6. Clifford Yapp MS Growth of  $\text{CuIn}_x\text{Ga}_{1-x}(\text{SySe}_{1-y})_2$  for Photovoltaic Applications (graduated spring 2006)
7. Tiffany Denny MS Nanofabrication of ZnO (graduated MS, spring 2006)
8. Beverly Wright PhD Nanofabrication of ZnO (graduated 5/2011)
9. Michael Burrows PhD Role of H in Si-based Photovoltaics (graduated 6/2009)
10. Sarah Rickman MS Growth of  $\text{CuIn}_x\text{Ga}_{1-x}(\text{SySe}_{1-y})_2$  for Photovoltaic Applications (graduated MS, spring 2006)
11. Fang Fang PhD Energy Band Alignment in Renewable Energy (graduated 7/2011)
12. Susan Huang PhD Liquid phase epitaxy for Photovoltaic Applications (graduated 10/2011)
13. Bhumika Chhabra PhD Passivation for high efficiency solar cells (graduated 8/2010)
14. Balakrishnam Jampana PhD GaN Solar Cells (graduated 8/2010)
15. Dan Yang PhD Low-k Materials for Integrated Circuits (graduated 8/2013)
16. Jonathon Church PhD Inverse Photoemission (graduated 7/2015)
17. Luke Costello MS Surface Passivation for Photovoltaics (graduated 8/2013)
18. Kevin Jones PhD Band Alignment in  $(\text{Ag}, \text{Cu})(\text{Ga}, \text{In})(\text{S}, \text{Se})$  Solar Cells (graduated 1/2018)
19. Ken Schmeider PhD GaAsP/SiGe Tandem Solar Cells (graduated 2/2013)
20. Nicole Kotulak PhD Induced Junction Solar Cells (graduated 8/2014)
21. James Krajewski PhD Metal/polymer interfaces for organic electronics (graduated 2016)
22. Xi Lin PhD Atomic Layer Etching (graduated 7/2018)
23. Bo Yuan PhD Light Trapping for Tandem PV (graduated 10/2017)
24. Meixi Chen PhD Organic Passivation and Induced Junctions in Silicon Photovoltaics (graduated 12/2017)
25. Glenn Catlin PhD Mechanics of Porous Low-k Materials for Integrated Circuits (graduated 2018)
26. Jimmy Hack PhD Hybrid Organic/Si Solar Cells (graduated 3/2020)

27. Abhishek Iyer PhD
28. Zijian Wang PhD
29. David Alejandro Angel PhD
30. Guancheng Li PhD
31. Omar Melton PhD
32. Moses Haimbodi post-doc
33. Guangming Liu post-doc MBE of GaSb Quantum Dots