**Interface Chemistry for Organic Electronics and Opto-electronics**

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**Abstract:**

Organic semiconductors and hybrid/organic materials have attracted interest for electronic applications due to their potential for use in low-cost, large-area, flexible electronic devices. Here we will report on recent developments pertaining to surface modifiers and both n- and p-dopants that could impact the charge injection/collection processes in organic light emitting diodes, organic field effect transistors, and organic photovoltaic and hybrid organic/inorganic perovskite devices. We will also discuss the development of organic and metallo-organic-based dimers as n-dopants and very briefly described metal dithiolene complexes as p-dopants for organic semiconductors and their impact of device performance. I will highlight the application of n-doping for the development of electron injection layers for organic light emitting diodes (OLEDs), and their use for doping of electron transport materials which result in high conductivities and in some cases good thermoelectric performance. In the case of OLEDs, it will be shown that photoactivation can lead to stable doping of materials (i.e. the doping induced conductivity remains relative constant over hundreds of hours) beyond the expected thermodynamic limit, which would be predicted based on a assessment of the effective reduction potential of the n-dopant and the reduction potential of the electron transport material.

**Selected References:**

1. “n-Doping of Organic Electronic Materials using Air-Stable Organometallics,” *Adv. Mater*. **24** (5), 699-703 (February 2012, DOI: 10.1002/adma.201103238)
2. “Electrode Work Function Engineering with Phosphonic Acid Monolayers and Molecular Acceptors: Charge Redistribution Mechanisms.” *Adv. Funct. Mater.*  **1704438**/1-12 (2018, DOI:[10.1002/adfm.201704438](http://dx.doi.org/10.1002/adfm.201704438))
3. “Solution doping of organic semiconductors using air-stable n-dopants.” *Appl. Phys. Lett*. **100**, 083305 (February 2012)
4. “A universal method to produce low work function electrodes for organic electronics,” *Science* **336** (6079), 327-332 (April 2012, DOI: 10.1126/science.1218829)
5. “Surface modified fullerene electron transport layers for stable and reproducible flexible perovskite solar cells.” *Nano Energy* **49**, 324-332 (2018, DOI:[10.1016/j.nanoen.2018.04.068](https://doi.org/10.1016/j.nanoen.2018.04.068))
6. “Ultralow doping in organic semiconductors: Evidence of trap filling.” *Phys. Rev. Lett*. **109** (17), 176601/1-5 (November 2012, DOI: 10.1103/PhysRevLett.109.176601)
7. “Reduction of contact resistance by selective contact doping in fullerene n-channel organic field-effect transistors.” *Appl. Phys. Lett.* **102**, 153303-153307 (April 2013, DOI: 10.1063/1.4802237)
8. “Modification of the fluorinated tin oxide/electron-transporting material interface by a strong reductant and its effect on perovskite solar cell efficiency.” *Mol. Syst. Des. Eng.* Advance Article (2018, DOI:[10.1039/C8ME00031J](http://doi.org/10.1039/C8ME00031J))
9. “Production of Heavily n- and p-Doped CVD Graphene with Solution-Processed Redox-Active Metal-Organic Species," *Materials Horizons* Advance Article (September 2013, DOI: 10.1039/C3MH00035D
10. “Controllable, Wide-Ranging n-Doping and p-Doping of Monolayer Group 6 Transition-Metal Disulfides and Diselenides.” *Adv. Mater.* **30**, 1802991 (2018, DOI: [10.1002/adma.201802991](http://doi.org/10.1002/adma.201802991))

**Biography**

Seth Marder is currently the Georgia Power Chair of Energy Efficiency and Regents’ Professor in the School of Chemistry and Biochemistry and a Professor of Materials Science and Engineering (courtesy) at the Georgia Institute of Technology (Georgia Tech). Dr. Marder received his undergraduate degree in Chemistry from Massachusetts Institute of Technology in 1978 and his Ph.D. from the University of Wisconsin-Madison in 1985. After completing his postdoctoral work at the University of Oxford from 1985–1987, he moved to the Jet Propulsion Laboratory (JPL) at California Institute of Technology (Caltech).

Marder has serves on numerous advisory boards for journals and is the Founding Chair of the Editorial Board for the Royal Society of Chemistry flagship materials journal, Materials Horizons.

He is a Fellow of the American Association for the Advancement of Science (2003), the Optical Society of America (2004), SPIE (2006), the Royal Society of Chemistry (2007), the American Physical Society (2009) the Materials Research Society (2014) and The National Academy of Inventors (2016). He received a American Chemical Society A.C. Cope Scholar Award, and the MRS Mid-Career Award. He was recently Awarded Georgia Tech’s Class of 1934 Distinguished Professor Award- Georgia Tech highest recognition for a faculty member.

According to Google Scholar he has an H-index >100, and over 50,000 citation, and has 39 granted patents.