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Engineering & Scientific Consulting

# Armantas Melianas, Ph.D.

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## Professional Profile

Dr. Melianas' expertise lies in semiconductor devices, polymers, electronics, optics, laser spectroscopy, and materials characterization. He has 10 years of experience in the development and failure analysis of various semiconductor technologies, including light-emitting diodes (LEDs), solar cells, electrochemical sensors, bioelectronic devices and non-volatile memories. His knowledge includes device microfabrication as well as printed and flexible electronic circuits. He excels solving problems related to yield, materials compatibility, and chemical safety (e.g., electrolyte leakage in ionic devices). In addition, Dr. Melianas has deep knowledge concerning materials and device characterization using various optical and electrical techniques, including pulsed laser systems and high-speed electrical measurements on custom-made printed circuit boards (PCBs). He has substantial experience in the analysis, signal processing, and modeling of datasets using MATLAB, and has worked on modeling semiconductor devices, such as solar cells, using Monte Carlo simulations.

Before joining Exponent, Dr. Melianas was a postdoctoral fellow at Stanford University where he developed microscale solid-state ionic memories using battery materials (e.g., block copolymers, emerging 2D materials, solid-state and liquid electrolytes, proton conductors, and ionic liquids) that were intended for artificial neural network (ANN) accelerators. Using microfabrication and high-speed electrical measurements, he developed fast switching and highly reliable solid-state ionic memories. In collaboration with Sandia National Laboratories, he built ionic memory arrays that facilitated more energy efficient and faster ANN accelerators compared to what was previously possible. Dr. Melianas later developed the first electrochemical random-access memory (ECRAM) using 2D titanium carbide MXene, paving the way for ionic memory integration into semiconductor chips. While at Stanford, he also worked on novel electrochemical sensors and bioelectronics applications, such as coupling electrochemical devices with live cells.

Before joining Stanford, Dr. Melianas' graduate research focused on the investigation of fundamental efficiency limits in organic solar cells. He elucidated device performance tradeoffs using ultrafast laser spectroscopy, custom-built electrical and optical setups, Monte Carlo device simulations, and other thin-film and device characterization techniques. He is intimately familiar with solution-processing of thin-films and structure-property relationships in polymeric and molecular blends. Dr. Melianas also consulted the graduate research spin-off company Epishine, where he came up with an experimental method to reveal the root cause failure of roll-to-roll printed solar cells related to water ingress.

## Academic Credentials & Professional Honors

Ph.D., Applied Physics, Linköping University, 2017

M.S., Materials Technology, Vilnius University, 2012

B.S., Physics, Vilnius University, 2010

Wallenberg Foundation Postdoctoral Fellowship Award, Stanford University, 2017

## Academic Appointments

Postdoctoral Researcher, Stanford University, 2017-2021

Visiting Researcher, Stanford University, Spring 2016

Graduate Researcher, Linköping University, 2012-2017

## Professional Affiliations

Member, IEEE

Member, IEEE Electron Devices Society

## Languages

Lithuanian

Russian

## Publications

Tan STM, Keene ST, Giovannitti A, Melianas A, Moser M, Iain McCulloch I, Salleo A. Operation mechanism of organic electrochemical transistors as redox chemical transducers. ChemRxiv preprint 2021; ChemRxiv:14546946

Gumyusenge A, Melianas A, T Keene S, Salleo A. Materials strategies for organic neuromorphic devices. Annual Review of Materials Research 2021; 51:- (Volume publication date July 2021)

Melianas A, Kang M, VahidMohammadi A, Tian W, Gogotsi Y, Salleo A, Hamedi MM. High-speed ionic synaptic memory based on two-dimensional titanium carbide MXene. arXiv preprint 2021; arXiv:2104.05396

Li Y, Xiao TP, Bennett CH, Isele E, Melianas A, Tao H, Marinella MJ, Salleo A, Fuller EJ, Talin AA. In situ parallel training of analog neural network using electrochemical random-access memory. Frontiers in Neuroscience 2021; 15:636127

Tan STM, Giovannitti A, Melianas A, Moser M, Cotts BL, Singh D, McCulloch I, Salleo A. High- gain chemically gated organic electrochemical transistor. Advanced Functional Materials 2021; 31:2010868

Melianas A, Quill TJ, LeCroy G, Tuchman Y, Loo Hv, Keene ST, Giovannitti A, Lee HR, Maria IP, McCulloch I, Salleo A. Temperature-resilient solid-state organic artificial synapses for neuromorphic computing. Science advances 2020; 6:eabb2958

Keene ST, Lubrano C, Kazemzadeh S, Melianas A, Tuchman Y, Polino G, Scognamiglio P, Cinà L, Salleo A, Burgt Yvd, Santoro F. A biohybrid synapse with neurotransmitter-mediated plasticity. Nature Materials 2020; 19:969-973

Wilken S, Upreti T, Melianas A, Dahlström S, Persson G, Olsson E, Österbacka R, Kemerink M. Experimentally calibrated kinetic Monte Carlo model reproduces organic solar cell current–voltage curve.

Solar RRL 2020; 4:2000029

Felekidis N, Melianas A, Kemerink M. The role of delocalization and excess energy in the quantum efficiency of organic solar cells and the validity of optical reciprocity relations. The Journal of Physical Chemistry Letters 2020; 11:3563-3570

Karuthedath S, Gorenflot J, Melianas A, Kan Z, Kemerink M, Laquai F. Buildup of triplet-state population in operating TQ1:PC71BM devices does not limit their performance. The Journal of Physical Chemistry Letters 2020; 11:2838-2845

Melianas A, Felekidis N, Puttisong Y, Meskers SCJ, Inganäs O, Chen WM, Kemerink M. Nonequilibrium site distribution governs charge-transfer electroluminescence at disordered organic heterointerfaces. Proceedings of the National Academy of Sciences 2019; 116:23416-23425

Fuller EJ, Li Y, Bennet C, Keene ST, Melianas A, Agarwal S, Marinella MJ, Salleo A, Talin AA. Redox transistors for neuromorphic computing. IBM Journal of Research and Development 2019; 63:9: 1-9: 9

Fuller EJ, Keene ST, Melianas A, Wang Z, Agarwal S, Li Y, Tuchman Y, James CD, Marinella MJ, Yang JJ, Salleo A, Talin AA. Parallel programming of an ionic floating-gate memory array for scalable neuromorphic computing. Science 2019; 364:570-574

Roland S, Kniepert J, Love JA, Negi V, Liu F, Bobbert P, Melianas A, Kemerink M, Hofacker A, Neher D. Equilibrated charge carrier populations govern steady-state nongeminate recombination in disordered organic solar cells. The Journal of Physical Chemistry Letters 2019; 10:1374-1381

Melianas A, Kemerink M. Photogenerated charge transport in organic electronic materials: experiments confirmed by simulations. Advanced Materials 2019; 31:1806004

Keene ST, Melianas A, Burgt Yvd, Salleo A. Mechanisms for enhanced state retention and stability in redox- gated organic neuromorphic devices. Advanced Electronic Materials 2018; 5:1800686

Felekidis N, Melianas A, Aguirre LE, Kemerink M. Comment on “Charge carrier extraction in organic solar cells governed by steady-state mobilities". Advanced Energy Materials 2018; 8:1800419

Felekidis N, Melianas A, Kemerink M. Automated open-source software for charge transport analysis in single-carrier organic semiconductor diodes. Organic Electronics 2018; 61:318-328

Burgt Yvd, Melianas A, Keene ST, Malliaras G, Salleo A. Organic electronics for neuromorphic computing. Nature Electronics 2018; 1:386-397

Jasiūnas R, Melianas A, Xia Y, Felekidis N, Gulbinas V, Kemerink M. Dead ends limit charge carrier extraction from all- polymer bulk heterojunction solar cells. Advanced Electronic Materials 2018; 4:1800144

Tang Z, Wang J, Melianas A, Wu Y, Kroon R, Li W, Ma W, Andersson MR, Ma Z, Cai W, Tress W, Inganäs O. Relating open-circuit voltage losses to the active layer morphology and contact selectivity in organic solar cells. Journal of Materials Chemistry A 2018; 6:12574-12581

Keene ST, Melianas A, Fuller EJ, Burgt Yvd, Talin AA, Salleo A. Optimized pulsed write schemes improve linearity and write speed for low-power organic neuromorphic devices. Journal of Physics D: Applied Physics 2018; 51:224002

Karuthedath S, Melianas A, Kan Z, Pranculis V, Wohlfahrt M, Khan JI, Gorenflot J, Xia Y, Inganäs O, Gulbinas V, Kemerink M, Frédéric Laquai F. Thermal annealing reduces geminate recombination in TQ1:N2200 all-polymer solar cells. Journal of Materials Chemistry A 2018; 6:7428-7438

Bergqvist J, Österberg T, Melianas A, Aguirre LE, Zheng Tang, Cai W, Ma Z, Kemerink M, Gedefaw D, Andersson MR, Inganäs O. Asymmetric photocurrent extraction in semitransparent laminated flexible organic solar cells. Nature Flexible Electronics 2018; 2:4

Felekidis N, Melianas A, Kemerink M. Design rule for improved open-circuit voltage in binary and ternary organic solar cells. ACS Applied Materials & Interfaces 2017; 9:37070-37077

Melianas A, Pranculis V, Spoltore D, Benduhn J, Inganäs O, Gulbinas V, Vandewal K, Kemerink M. Charge transport in pure and mixed phases in organic solar cells. Advanced Energy Materials 2017; 7:1700888

Mendaza ADdZ, Melianas A, Nugroho FAA, Backe O, Olsson E, Langhammer C, Inganäs O, Mueller C. A fullerene alloy based photovoltaic blend with a glass transition temperature above 200°C. Journal of Materials Chemistry A 2017; 5:4156-4162

Melianas A, Pranculis V, Xia Y, Felekidis N, Inganäs O, Gulbinas V, Kemerink M. Photogenerated carrier mobility significantly exceeds injected carrier mobility in organic solar cells. Advanced Energy Materials 2017; 7:1602143

Abramavicius V, Pranculis V, Melianas A, Inganäs O, Gulbinas V, Abramavicius D. Role of coherence and delocalization in photo-induced electron transfer at organic interfaces. Scientific Reports 2016; 6:1-7

Felekidis N, Melianas A, Kemerink M. Nonequilibrium drift-diffusion model for organic semiconductor devices. Physical Review B 2016; 94:035205

Bergqvist J, Tress W, Forchheimer D, Melianas A, Tang Z, Haviland D, Inganäs O. New method for lateral mapping of bimolecular recombination in thin- film organic solar cells. Progress in Photovoltaics: Research and Applications 2016; 24:1096-1108

Tang Z, Elfwing A, Melianas A, Bergqvist J, Bao Q, Inganäs O. Fully-solution-processed organic solar cells with a highly efficient paper-based light trapping element. Journal of Materials Chemistry A 2015; 3:24289-24296

Melianas A, Etzold F, Savenije TJ, Laquai F, Inganäs O, Kemerink M. Photo-generated carriers lose energy during extraction from polymer-fullerene solar cells. Nature Communications 2015; 6:8778

Mendaza ADdZ, Melianas A, Rossbauer S, Bäcke O, Nordstierna L, Erhart P, Olsson E, Anthopoulos TD, Inganäs O, Müller C. High- entropy mixtures of pristine fullerenes for solution- processed transistors and solar cells. Advanced Materials 2015; 27:7325-7331

Kroon R, Melianas A, Zhuang W, Bergqvist J, Mendaza ADdZ, Steckler TT, Yu L, Bradley SJ, Musumeci C, Gedefaw D, Nann T, Amassian A, Müller C, Inganäs O, Andersson MR. Comparison of selenophene and thienothiophene incorporation into pentacyclic lactam-based conjugated polymers for organic solar cells. Polymer Chemistry 2015; 6:7402-7409 (shared first author)

Tang Z, Liu B, Melianas A, Bergqvist J, Tress W, Bao Q, Qian D, Inganäs O, Zhang F. A new fullerene- free bulk- heterojunction system for efficient high- voltage and high- fill factor solution- processed organic photovoltaics. Advanced Materials 2015; 27:1900-1907

Melianas A, Pranculis V, Devižis A, Gulbinas V, Inganäs O, Kemerink M. Dispersion- dominated photocurrent in polymer:fullerene solar cells. Advanced Functional Materials 2014; 24:4507-4514

Andersson LM, Melianas A, Infahasaeng Y, Tang Z, Yartsev A, Inganäs O, Sundström V. Unified study of recombination in polymer:fullerene solar cells using transient absorption and charge-extraction

measurements. The Journal of Physical Chemistry Letters 2013; 4:2069-2072

Murthy DHK, Armantas Melianas A, Tang Z, Juška G, Arlauskas K, Zhang F, Siebbeles LDA, Inganäs O, Savenije TJ. Origin of reduced bimolecular recombination in blends of conjugated polymers and fullerenes. Advanced Functional Materials 2013; 23:4262-4268

**Presentations**

Melianas A. Artificial synapses made with conjugated polymers: a new high-performance device for brain-like computing. Oral presentation, PARC, a Xerox Company, Palo Alto, CA, 2018

Melianas A. Non-volatile analog synapses with linear resistance tuning for low-power neuromorphic computing. Oral presentation, Semiconductor Research Corporation (SRC) TECHCON meeting, Austin, TX, 2018

Melianas A. Artificial synapses made with conjugated polymers: a new high-performance device. Oral presentation, Gordon Research Seminar (GRS): Electronic Processes in Organic Materials, Lucca, Italy, 2018

Melianas A. Artificial synapses made with conjugated polymers: a new high-performance device. Poster presentation, 47th Electronic Materials Symposium, Santa Clara, CA, 2018

Melianas A. Polymer-based non-volatile analog synapses for low-power neuromorphic computing. Poster presentation, Materials Research Society (MRS) Spring Meeting, Phoenix, AZ, 2018

Melianas A. Fullerene domains with low donor concentration enable hole transport by tunneling in organic solar cells. Oral presentation, 12th International Conference on Optical Probes of Organic and Hybrid Semiconductors, Quebec, Canada, 2017

Melianas A. Photo-generated carriers lose energy during extraction from organic solar cells. Oral presentation. Materials Research Society (MRS) Fall Meeting, Boston, MA, 2016

Melianas A. Photo-generated carriers lose energy during extraction from organic solar cells. Oral presentation. International Conference on the Science and Technology of Synthetic Metals (ICSM), Guangzhou, China, 2016

Melianas A. Physics of organic solar cells. New Trends and Faces III Photophysics in Organic Materials. Oral presentation, Stellenbosch, South Africa, 2015 (invited)

Melianas A. (Un)avoidable energy loss during carrier extraction in polymer:fullerene solar cells. Oral presentation, 12th International Symposium on Functional π-Electron Systems (Fπ-12), Seattle, WA, 2015

Melianas A. (Un)avoidable energy loss during carrier extraction in polymer:fullerene solar cells. Poster presentation, 13th European Conference on Molecular Electronics (ECME), Strasbourg, France, 2015

Melianas A. Dispersion-dominated photocurrent in polymer:fullerene solar cells. Oral presentation, European Materials Research Society (e-MRS) Spring Meeting, Lille, France, 2014

Melianas A. Dispersion-dominated photocurrent in polymer:fullerene solar cells. Poster presentation, Gordon Research Conference (GRC): Electronic Processes in Organic Materials, Lucca, Italy, 2014

## Project Experience

Optical characterization at the component, device, and system levels

Assessment of optical safety of prototype lasers and LEDs

Electrical failure analysis of PCBs, sensors, and battery management units

Review of trade secrets and patents for optoelectronics applications

## Additional Education & Training

Stanford Ignite, Certificate Program in Innovation and Entrepreneurship, Stanford University Graduate School of Business, June-July 2020

Cert Prep: AutoCAD Certified Professional, LinkedIn, March 2018

CS230: Deep Learning, Stanford University, March 2018

Neural Networks and Deep Learning, Coursera, November 2017

Machine Learning, Coursera, October 2016

## Editorships & Editorial Review Boards

Review Editor for Frontiers in Neuroscience | Neuromorphic Engineering

## Peer Reviewer

Nature Electronics

Nature Communications

Advanced Materials

Advanced Energy Materials

Advanced Functional Materials

Advanced Electronic Materials

Advanced Optical Materials

Science Advances