

Curriculum vitae di Alberto Salleo

PE3_4: Electronic properties of materials, surfaces, interfaces, nanostructure

PE3_13: Structure and dynamics of disordered systems, e.g. soft matter

PE5_4: Thin Films

PERSONAL DETAILS

Family name, First name: Salleo, Alberto

Birthdate: April 3rd 1971

Researcher unique identifier(s) (such as ORCID, Research ID, etc. ...): 0000-0002-7448-9123

URL for web site: salleo.stanford.edu

• **Education and key qualifications**

01/12/2001 PhD
Department of Materials Science and Engineering, UC Berkeley

2000 Master's
Department of Materials Science and Engineering, UC Berkeley

1994 Laurea
Dipartimento di Chimica, Università di Roma *La Sapienza*

• **Current position(s)**

2019 - Full Professor, Department of Materials Science and Engineering, Stanford University, USA
2025 – Deputy Director and Chief Research Officer
SLAC National Accelerator Laboratory, Menlo Park, USA

• **Previous position(s)**

2019-2025 Chair, Department of Materials Science and Engineering, Stanford University, USA
2016 Visiting Professor, École des Mines de Saint-Étienne, Gardanne campus, France
2013-2019 Associate Professor of Materials Science, Stanford University, USA
2005-2012 Assistant Professor of Materials Science, Stanford University, USA
2004-2005 Member of Research Staff, PARC Inc. (formerly Xerox PARC), USA
2001-2004 Post-doctoral research fellow, PARC Inc. (formerly Xerox PARC), USA

RESEARCH ACHIEVEMENTS AND PEER RECOGNITION

Research achievements

Summary of bibliometric indicators:

Publications: over 300 peer reviewed articles (23 in *Nature* family journals of which 11 in *Nature Materials*, 3 in *Science*, 3 in *Science Advances*, 5 in *PNAS*), 15 highly-cited papers, 20 conference proceedings, 8 book chapters, 2 edited books, 37 US Patents Awarded.

h=103 with >42,000 citations (Clarivate); h=121 with >55,000 citations (Google Scholar)

Clarivate Highly-Cited Researcher in Materials Science since 2015.

Conferences and seminars: Delivered a total of over 160 invited presentations. 12 of these were keynotes/plenary/distinguished lectures and over 35 department seminars.

Research Outputs

In all the manuscripts below, I acted as the PI of the project, contributing to the ideation, directing and supervising the research and editing the manuscripts. In all of them I am a corresponding author. The papers

from my group span from very fundamental structure-property studies of materials all the way to device design and device physics.

1. J. Treiber, Z.M. Chao, R. McCoy, Z.X. Lu, A. Wheeler, Q. Thiburce, R.M. Owens, S. Daniel, A. Salleo, "Reproducible High-Impedance Supported Lipid Bilayers on PEDOT:PSS", *Advanced Functional Materials* **36**, e28703 (2026).
Devised a robust protocol to fabricate lipid bilayers over polymer electrodes for biomimetic sensing. These sensors have been used, albeit with reproducibility issues until this work, to detect toxins, ion channel poisoning and viral fusion, all on chip, in a team with collaborators, producing over 10 original manuscripts.
2. Y. Tsarfati, K. C. Bustillo, B. H. Savitzky, L. Balhorn, T. J. Quill, A. Marks, J. Donohue, S. E. Zeltmann, C. J. Takacs, A. Giovannitti, I. McCulloch, C. Ophus, A. M. Minor, A. Salleo, "The hierarchical structure of organic mixed ionic-electronic conductors and its evolution in water," *Nature Materials* **24**, 101 (2025).
This is the first paper that shows the use of TEM to characterized vitrified samples of conjugated polymers swollen with aqueous electrolyte. Surprisingly, swelling up to ~50% does not affect significantly the microstructure of the polymer, which explains its robustness in terms of electronic transport, an observation hitherto unexplained.
3. G. LeCroy, R. Ghosh, P. Sommerville, C. Burke, H. Makki, K. Rozylowicz, C. Cheng, M. Weber, W. Khelifi, N. Stingelin, A. Troisi, C. Luscombe, F. C. Spano, A. Salleo, "Using molecular structure to tune intrachain and interchain charge transport in indacenodithiophene-based copolymers," *Journal of the American Chemical Society* **146**, 21778 (2024).
We used a combination of TEM, spectroscopies from the mid-IR to the UV and theory to show that 1D transport and occasional chain hop is an efficient transport paradigm in conjugated polymers, as long as charge delocalization along the chain is sufficient. This finding upends the paradigm that 2D delocalization is advantageous for charge transport.
4. C. Cheng, Y. Wu, C. Cendra, S. Schneider, J. Treiber, P. Agarwala, E. D. Gomez, Z. Bao, C. Takacs, M. F. Toney, A. Salleo, "Impact of dilute DIO additive on local microstructure of fluorinated, pNDI-based polymer solar cells," *Advanced Materials* **36**, 2409502 (2024).
We used a combination of TEM and quantitative x-ray diffraction to determine the microstructural effect of additives in all-polymer solar cells. Characterizing quantitatively all-polymer solar cells blend remains an open challenge in the field.
5. G. S. LeCroy, R. Ghosh, V. Untilova, L. Guio, K. H. Stone, M. Brinkmann, C. Luscombe, F. C. Spano, A. Salleo, "Polaron absorption in aligned conjugated polymer films: breakdown of adiabatic treatments and going beyond the conventional mid-gap state model," *Materials Horizons* **11**, 545 (2024).
Using melt-aligned polymer films and polarized mid-IR charge modulation spectroscopy we prove incontrovertibly that the widely accepted "mid-gap" polaron model, used since the '90s in conjugated polymers is incorrect and that the Born-Oppenheimer approximation is violated in photon absorption by polarons in conjugated polymers. Using a new theory we are able to measure polaron delocalization and show that they delocalize in 2D in a certain semicrystalline polymer.
6. T. J. Quill, G. S. LeCroy, A. Marks, S. A. Hesse, Q. Thiburce, I. McCulloch, C. J. Tassone, C. J. Takacs, A. Giovannitti, A. Salleo, "Charge carrier induced structural ordering and disordering in organic mixed ionic electronic conductors," *Advanced Materials* **36**, 2310157 (2024).
Using UV-vis spectroelectrochemistry and *operando* synchrotron-based x-ray diffraction we show that conjugated polymers in aqueous electrolytes order upon charging and that degradation at high charge density is inherently microstructural and due to the formation of bipolarons.
7. T. J. Quill, G. LeCroy, D. M. Halat, R. Sheelamantula, A. Marks, L. S. Grundy, I. McCulloch, J. A. Reimer, N. P. Balsara, A. Giovannitti, A. Salleo, C. J. Takacs, "An ordered, self-assembled nanocomposite with efficient electronic and ionic transport," *Nature Materials* **22**, 362 (2023).
Introduced for the first time synchrotron-based *operando* characterization of organic mixed conductors and showed that polymer-ionic liquid composites become more ordered upon charging, explaining why their performance improves.
8. L. Balhorn, Q. MacPherson, K. C. Bustillo, C. J. Takacs, A. J. Spakowitz, A. Salleo, "Closing the loop between microstructure and charge transport in conjugated polymers by combining microscopy and simulation," *Proc. Nat. Acad. Sci. USA* **119**, e2204346119 (2022).

First demonstration of the use of TEM on conjugated polymers to extract a microstructure to be used as a starting point for realistic transport simulations. We showed that conformational disorder plays a crucial role in charge transport.

9. S. T. Keene, W. Michaels, A. Melianas, T. J. Quill, E. J. Fuller, A. Giovannitti, I. McCulloch, A. A. Talin, C. J. Tassone, J. Qin, A. Troisi, A. Salleo, "Efficient electronic tunneling governs transport in conducting polymer-insulator blends," *Journal of the American Chemical Society* **144**, 10368 (2022).
Using transport measurements and small-angle x-ray scattering combined with theory we show that tunnelling in an insulating phase plays a crucial role in transport in the most widely-used conjugated polymer blend.
10. S. T. M. Tan, G. Lee, I. Denti, G. LeCroy, K. Rozyłowicz, A. Marks, S. Griggs, I. McCulloch, A. Giovannitti, A. Salleo, "Tuning organic electrochemical transistor threshold voltage using chemically doped polymer gates," *Advanced Materials* **34**, 2202359 (2022).
Instead of using a standard gate electrode in electrochemical transistors, we show that using a doped polymer allows to control the threshold voltage of the device, akin to how the threshold is controlled with doped gates in Si technology. This property is of paramount importance in circuit design.
11. A. Melianas, T.J. Quill, G. LeCroy, Y. Tuchman, H.v. Loo, S.T. Keene, A. Giovannitti, H.R. Lee, I.P. Maria, I. McCulloch, A. Salleo, "Temperature-Resilient Solid-State Organic Artificial Synapses for Neuromorphic Computing," *Science Advances* **6**, eabb2958 (2020).
Fabricated and characterized for the first time polymer-based all solid-state artificial synapses with record-breaking performance in terms of speed, power consumption and endurance.
12. S. T. Keene, C. Lubrano, S. Kazemzadeh, A. Melianas, Y. Tuchman, G. Polino, P. Scognamiglio, L. Cina, A. Salleo, Y. van de Burgt, F. Santoro, "A Biohybrid Synapse with Neurotransmitter-Mediated Plasticity," *Nature Materials* **19**, 969 (2020).
Connected a polymer-based artificial synapse with neuron-like cells and used redox reactions on neurotransmitters to modulate the artificial synapse. This is the first example of an ECRAM controlled by living matter.
13. D. A. Hanifi, N.D. Bronstein, B.A. Koscher, Z. Nett, J.K. Swabeck, K. Takano, A.M. Schwartzberg, L. Maserati, K. Vandewal, Y. van de Burgt, A. Salleo, A.P. Alivisatos, "Redefining near-unity luminescence in quantum dots with photothermal threshold quantum Yield," *Science* **363**, 1199 (2019).
Built the most accurate luminescence quantum yield set-up to date and used it to characterize the quantum yield of record-breaking emissive quantum dots made by the Alivastos group (QY=99.6%). The set-up was instrumental in optimizing the quantum dot performance.
14. E. J. Fuller, S. T. Keene, A. Melianas, Z.R. Wang, S. Agarwal, Y. Li, Y. Tuchman, C.D. James, M.J. Marinella, J.J. Yang, A. Salleo, A.A. Talin, "Parallel Programming of an Ionic Floating-Gate Memory Array for Scalable Neuromorphic Computing," *Science* **364**, 570 (2019).
Demonstrated fabrication and parallel programming of a 3x3 array of polymer-based artificial synapses.
15. O. Parlak, S. T. Keene, A. Marais, V. F. Curto, A. Salleo, "Molecularly selective nanoporous membrane-based wearable organic electrochemical device for noninvasive cortisol sensing", *Science Advances* **4**, eaar2904 (2018).
Fabricated a wearable flexible sensor able to measure cortisol from human sweat. This was the first example of electrochemical sensing of cortisol in a wearable device.
16. Y. van de Burgt, E. Lubberman, E. J. Fuller, S. T. Keene, G. C. Faria, S. Agarwal, M. J. Marinella, A. A. Talin, A. Salleo, "A non-volatile organic electrochemical device as a low-voltage artificial synapse for neuromorphic computing", *Nature Materials* **16**, 414 (2017).
Described, fabricated and characterized the first polymer-based artificial synapse based on an ECRAM device. This paper launched the field of organic ECRAMs.
17. K. Vandewal, S. Albrecht, E.T. Hoke, K.R. Graham, J. Widmer, J.D. Douglas, M. Schubert, W.R. Mateker, J.T. Bloking, G.F. Burkhard, A. Sellinger, J.M.J. Frechet, A. Amassian, M.K. Riede, M.D. McGehee, D. Neher, A. Salleo, "Efficient charge generation by relaxed charge-transfer states at organic interfaces," *Nature Materials* **13**, 63-68 (2014).
We used a combination of techniques to provide the most sensitive optical absorption measurement to date (up to 3 orders more sensitive than previous methods). We used this measurement to prove the mechanism of charge generation in organic solar cells and end a decade-long controversy.

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18. R. Noriega, J. Rivnay, K. Vandewal, F.P.V. Koch, N. Stingelin, P. Smith, M.F. Toney, A. Salleo, "A general relationship between disorder, aggregation and charge transport in conjugated polymers," *Nature Materials*, **12**, 1037-1043 (2013).
Synchrotron-based structural measurements and a detailed literature analysis were used to extract universal structure-property relationships related to charge transport in conjugated polymers. This paper is widely considered a "must-read" for researchers interested in charge transport.
19. J. Rivnay, R. Noriega, R. J. Kline, A. Salleo, M. F. Toney, "Quantitative analysis of lattice disorder and crystallite size in organic semiconductor thin films," *Physical Review B* **84**, 045203-1-2 (2011).
This 20-page paper describes in great detail how to analyze x-ray diffraction peak shape to extract quantitative disorder parameters in semicrystalline conjugated polymer films. It is considered the reference for anyone doing quantitative structural analysis of conjugated polymers.
20. J. Rivnay, L. Jimison, J. Northrup, M. Toney, R. Noriega, T. Marks, A. Facchetti, A. Salleo, "Large Modulation of Carrier Transport by Grain Boundary Molecular Packing and Microstructure in Organic Semiconductor Thin Films. Implications for Organic Transistor Performance," *Nature Materials* **8**, 952-958 (2009).
Directional processing, synchrotron-based x-ray diffraction and DFT were used to show how the structure of the unit cell affects charge transport across grain-boundaries in organic small-molecule semiconductors.

Peer recognition

Research and Scholarship Awards

- Fellow, American Association for the Advancement of Science (2025)
- Hong Seh and Vivian W. M. Lin Endowed Professorship in the School of Engineering (2025)
- Fellow, National Academy of Inventors (2024)
- Member, Academia Europaea (2023)
- Fellow, Materials Research Society (2022)
- Fellow, European Academy of Sciences (2021)
- Cavaliere (Knighthood): Ordine al Merito della Repubblica Italiana (2020)
- Denice Denton Diversity Emerging Leader Workshop participant (by invitation only) (2016)
- ISI/Clarivate Highly Cited Researcher (top 1% cited scientist) in Materials Science since 2015
- SPIE Early Career Award (2010)
- 3M Untenured Faculty Award (2007-2009)
- NSF Career Award (2007-2011)
- PARC Outstanding Performance Award: printed electronics (2003) and printed color filters (2004)
- Fulbright Fellow (1995-2000)

University Awards

- Walter J. Gores Award for excellence in teaching, Stanford's university-wide highest teaching honor, awarded to 3 faculty every year out of ~2,000 (2016)
- Tau Beta Pi School of Engineering Excellence in Undergraduate Teaching Award (2013)

ADDITIONAL INFORMATION

Other contributions to the research community

Research Management

Currently serving as Deputy Director for Science and Technology and Chief Research Officer at SLAC National Accelerator Laboratory. SLAC is one of the 10 Office of Science National Laboratories of the Department of Energy. With a budget of ~\$820M and employing ~1,800 staff, SLAC engages in research from high-energy physics and cosmology all the way to materials science and biology. SLAC is home to the first x-ray free-electron laser in the world and of a synchrotron-based light-source. All the Science and Technology mission of the laboratory rolls up to me (I report only to the laboratory director), where I am responsible for managing and coordinating the strategic vision of the whole laboratory.

Community and Outreach

- Board Member, Tech Europe Foundation, Milan (2024-present)
- Co-founder, Phlego Inc. a start-up company in the cement space (2025)
- Jury member of the start-up and scale-up competitions of the World Materials Forum (2022-2024)

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- Board member and member of the scientific council of the Italian Scholars and Scientists of North America Foundation (ISSNAF), the network of Italian scientists in North America (2019-2025) and co-founder of the Bay Area Chapter of ISSNAF (2017)
- Member of the Scientific Advisory Board of the Domaine d'Interêt Majeurs, Matériaux Anciens et Patrimoniaux, a French national research network for cultural heritage research (2019-present)
- Cantor Art + Science Fellows mentor (2014-2019): hosted and mentored undergraduate students to conduct materials science research in collaboration with the Cantor Museum at Stanford

Conference and Symposia Organization

- General Chair of the 2023 Bioelectronics Gordon Conference (with Caroline Ajo-Franklin)
- Co-organizer, Materials Research Society Meeting Symposia, Fall 2016, 2012, 2010, 2008, Spring 2022, 2012, 2007
- Elected Member, Organizing Committee, Electronic Materials Conference, 2010 - 2016

Editorial activities

- Board of Reviewing Editors, *Science*
- Founding Principal Editor of MRS Communications (2011-present)
- Guest co-editor MRS Bulletin issue themed Organic Semiconductors for Brain-Inspired Computing (w/ G. Malliaras).
- Associate Editor of Journal of Electronic Materials (2008-2015)
- Co-editor of the edited book *Wearable Bioelectronics* Elsevier (2018)
- Co-editor of the edited book *Flexible Electronics: Materials and Applications*, Springer Science (2009)