

Photonic Materials, A. Polman (2017-2022)

Biography



Prof. Albert Polman is program leader of the Light Management in new Photovoltaic Materials (LMPV) Program at the NWO Institute AMOLF in Amsterdam and professor of photonic materials for photovoltaics at the University of Amsterdam. He was director of AMOLF from 2006 to 2013.

Polman is one of the early pioneers of the research field of nanophotonics, a highly active research area worldwide. Polman's research group focuses on the study of fundamental light-matter interactions at the nanoscale. He studies light management at the nanoscale to realize solar cells with ultra-high efficiency that can be made at low costs. He develops optical metasurfaces for analog optical processing and develops cathodoluminescence spectroscopy as nanoscale imaging and spectroscopy technique.

Polman has published over 350 papers that were cited over 39.000 times. He is member of the Royal Netherlands Academy of Arts and Sciences (KNAW) and was elected in the inaugural class of the new Netherlands Academy of Engineering. He has won several awards for his work, including the ENI Renewable Energy Award (with Harry Atwater), the Science of Light Prize of the European Physical Society, the MRS Materials Characterization Award, the Physica prize of the Dutch Physical Society, and the Julius Springer Prize in Applied Physics. He was highly cited researcher in 2017-2019, was awarded three ERC Advanced Grants (2011, 2016, 2021) and has given over 200 keynote and invited talks at international conferences and workshops. Polman is co-founder of Delmic BV that brings an instrument for cathodoluminescence spectroscopy on the market that was developed in his group. Polman leads the Dutch national research, innovation and industrial development program SolarNL (www.solarnl.eu, 898 million euro) to build up and strengthen the photovoltaics industry in the Netherlands and Europe.

Group output 2017-2022

Peer reviewed Publications

2017

1. Y. Zhao, A.A.E. Saleh, M.A. van de Haar, B. Baum, J.A. Briggs, A. Lay, O.A. Reyes-Becerra and J.A. Dionne, *Nanoscopic control and quantification of enantioselective optical forces*, Nature Nanotechnol. **12**, 1055-1060 (2017).
2. V. Neder, S.L. Luxembourg and A. Polman, *Efficient colored silicon solar modules using integrated resonant dielectric nanoscatterers*, Appl. Phys. Lett. **111**, 073902: 1-5 (2017).
3. S. Meuret, T. Coenen, H. Zeijlemaker, M. Latzel, S. Christiansen, S. Conesa-Boj and A. Polman, *Photon bunching reveals single-electron cathodoluminescence excitation efficiency in InGaN quantum wells*, Phys. Rev. B **96**, 035308: 1-8 (2017).
4. B. Bruhn, B.J.M. Brenny, S. Dekker, I. Dogan, P. Schall and K. Dohnalova, *Multi-chromatic silicon nanocrystals*, Light : Sci. Appl. **6**, e17007: 1-8 (2017).
5. M.A. Verschuuren, M. Megens, Y.F. Ni, H.A. van Sprang and A. Polman, *Large area nanoimprint by substrate conformal imprint lithography (SCIL)*, Adv. Opt. Technol. **6**, (2017).
6. L. van Dijk, J. van de Groep, L.W. Veldhuizen, M. Di Vece and R.E.I. Schropp, *Concepts for external light trapping and its utilization in colored and image displaying photovoltaic modules*, Prog. Photovolt. : Res. Appl. **25**, 553–568 (2017).
7. B. Sciacca, A. Berkhout, B.J.M. Brenny, S.Z. Oener, M.A. van Huis, A. Polman and E.C. Garnett, *Monocrystalline Nanopatterns Made by Nanocube Assembly and Epitaxy*, Adv. Mater. **29**,

1701064: 1-6 (2017).

8. G. Yin, M.W. Knight, M.C. van Lare, M.M. Sola Garcia, A. Polman and M. Schmid, *Optoelectronic Enhancement of Ultrathin $\text{CuIn}_{1-x}\text{Ga}_x\text{Se}_2$ Solar Cells by Nanophotonic Contacts*, *Adv. Opt. Mater.* **5**, 1600637: 1-11 (2017).
9. N.M. Estakhri, V. Neder, M.W. Knight, A. Polman and A. Alù, *Visible Light, Wide-Angle Graded Metasurface for Back Reflection*, *ACS Photonics* **4**, 228-235 (2017).

2018

1. S. Meuret, M. M. Sola Garcia, T. Coenen, E. Kieft, H. Zeijlemaker, M. Latzel, S. Christiansen, S.Y. Woo, Y.H. Ra, Z. Mi and A. Polman, *Complementary cathodoluminescence lifetime imaging configurations in a scanning electron microscope*, *Ultramicroscopy* **197**, 28-38 (2018). **Green OA**
2. T. Coenen and A. Polman, *Energy-Momentum Cathodoluminescence Imaging of Anisotropic Directionality in Elliptical Aluminium Plasmonic Bullseye Antennas*, *ACS Photonics*, ASAP publication December 26, (2018). **Green OA**
3. H. Kwon, D.L. Sounas, A. Cordaro, A. Polman and A. Alù, *Nonlocal Metasurfaces for Optical Signal Processing*, *Phys.Rev.Lett.* **121**, 17, 173004: 1-6 (2018). **Green OA**
4. T. Holtus, L. Helmbrecht, H.C. Hendrikse, I. Baglai, S. Meuret, G.W.P. Adhyaksa, E.C. Garnett and W.L. Noorduin, *Shape-preserving transformation of carbonate minerals into lead halide perovskite semiconductors based on ion exchange/insertion reactions*, *Nature Chem.* **10**, 740-745 (2018). **Green OA**
5. L. Gagliano, M. Kruijse, J.D.D. Schefold, A. Belabbes, M. A. Verheijen, S. Meuret, S. Koelling, A. Polman, F. Bechstedt, J. E. M. Haverkort and E. P. A. M. Bakkers, *Efficient Green Emission from Wurtzite $\text{AlIn}_{1-x}\text{P}$ Nanowires*, *Nano Lett.* **18**, 6: 3543-3549 (2018). **Gold OA**
6. I.C. Bicket, E.P. Bellido, S. Meuret, A. Polman and G.A. Botton, *Correlative electron energy loss spectroscopy and cathodoluminescence spectroscopy on three-dimensional plasmonic split ring resonators*, *Microscopy* **67**, Suppl 1: i40-i51 (2018). **Green OA**
7. S. Meuret, T. Coenen, S.Y. Woo, Y.H. Ra, Z. Mi and A. Polman, *Nanoscale Relative Emission Efficiency Mapping Using Cathodoluminescence $g(2)$ Imaging*, *Nano Lett.* **18**, 4: 2288-2293 (2018). **Gold OA**
8. H. Lourenco-Martins, M. Kociak, S. Meuret, F. Treussart, Y. H. Lee, X. Y. Ling, H. -C. Chang and L. H. G. Tizei, *Probing Plasmon-NVO Coupling at the Nanometer Scale with Photons and Fast Electrons*, *ACS Photonics* **5**, 2: 324-328 (2018). **Gold OA**
9. S. Mignuzzi, M. Mota, T. Coenen, Y. Li, A.P. Mihai, P.K. Petrov, R. Oulton, S. Maier and R. Sapienza, *Energy-Momentum Cathodoluminescence Spectroscopy of Dielectric Nanostructures*, *ACS Photonics* **5**, 4: 1381-1387 (2018). **Gold OA**

2019

1. N. Talebi, M. Hentschel, S. Guo, S. Meuret, A. Polman, H. Giessen, P.A. van Aken, *Merging transformation optics with electron-driven photon sources*, *Nature Comm.* **10**, 599 (2019) **Gold OA**
2. S. Meuret, N. Schilder, H. Agrawal, E. Garnett, and A. Polman, *Spatial resolution of coherent cathodoluminescence super-resolution microscopy*, *J. Schefold, ACS Photon.* **6**, 1067 (2019) **Hybrid OA**
3. S. Peng, N. Schilder, X. Ni, J. van de Groep, A. Alù, A. Khanikaev, H.A. Atwater, and A. Polman, *Probing the bandstructure of topological silicon photonic lattices in the visible*, *Phys. Rev. Lett.* **122**, 117401 (2019) **Green OA**
4. V. Neder, A. Alu, Y. Ra'di, and A. Polman, *Combined metagratings for efficient broad-angle scattering metasurface*, *ACS Photon.* **6**, 1010 (2019) **Hybrid OA**
5. M.A. Verschuuren, M.W. Knight, M. Megens, and A. Polman, *Nanoscale spatial limitations of large-area substrate-conformal nano-imprint lithography (SCIL)*, *Nanotechnol.* **30**, 345301 (2019) **Green OA**

6. A. Polman, M. Kociak and J. García de Abajo, *Electron beam spectroscopy for nanophotonics*, Nature Mater. **18**, 1158 (2019) **Green OA**
7. S. Askes, N. Schilder, A. Polman, and E.C. Garnett, *Tunable plasmonic HfN nanoparticles and arrays*, Nanoscale **11**, 20252 (2019) **Green OA**
8. A. Cordaro, H. Kwong, A.F. Koenderink, A. Alù, and A. Polman, *High-index dielectric metasurfaces performing mathematical operations*, Nano Lett. **19**, 8418-8423, (2019) **Hybrid OA**
9. T. Fung, T.P.N. Veeken, D. Payne, B. Vettli, A. Polman, and M. Abbott, *Application and validity of the effective medium approximation to the optical properties of nanotextured silicon coated with a dielectric layer*, Optics Express, **27**, 38645-38660, (2019) **Gold OA**
10. S. Meuret, M.M. Sola Garcia, T. Coenen, E. Kieft, H. Zeijlemaker, M. Latzel, S. Christiansen, S.Y. Woo, Y.H. Ra, Z. Mi, and A. Polman, *Complementary cathodoluminescence lifetime imaging configurations in a scanning electron microscope*, Ultramicroscopy, vol. 197, 28–38, (2019) **Green OA**
11. T. Coenen and A. Polman, *Energy-Momentum Cathodoluminescence Imaging of Anisotropic Directionality in Elliptical Aluminium Plasmonic Bullseye Antennas*, ACS Photonics **6**, 573–580, (2019) **Hybrid OA**

2020

1. E.C. Garnett, B. Ehrler, A. Polman and E. Alarcón-Lladó, *Photonics for Photovoltaics – advances and opportunities*, ACS Photonics **8**, (1), 61-70 (2020) **Hybrid OA**.
2. B. Ehrler, E. Alarcón-Lladó, S.W. Tabernig, T. Veeken, E.C. Garnett and A. Polman, *Photovoltaics Reaching for the Shockley–Queisser Limit*, ACS Energy Lett. **5**, (9), 3029-3033 (2020).
3. N. van Nielsen, M. Hentschel, N.J. Schilder, H. Giessen, A. Polman and N. Talebi, *Electrons Generate Self-Complementary Broadband Vortex Light Beams Using Chiral Photon Sieves*, Nano Lett. **20**, (8), 5975-5981 (2020).
4. H. Kwon, A. Cordaro, D.L. Sounas, A. Polman and A. Alù, *Dual-Polarization Analog 2D Image Processing with Nonlocal Metasurfaces*, ACS Photonics **7**, (7), 1799-1805 (2020).
5. N.J. Schilder, H. Agrawal, E.C. Garnett and A. Polman, *Phase-Resolved Surface Plasmon Scattering Probed by Cathodoluminescence Holography*, ACS Photonics **7**, (6), 1476-1482 (2020) **Hybrid OA**.
6. F. Uleman, V. Neder, A. Cordaro, A. Alù and A. Polman, *Resonant Metagratings for Spectral and Angular Control of Light for Colored Rooftop Photovoltaics*, ACS Appl. Energy Mater. **3**, 4: 3150-3156 (2020) **Hybrid OA**.
7. N.J. Schilder, T.A.W. Wolterink, C. Mennes, R. Röhrich and A.F. Koenderink, *Phase-retrieval Fourier microscopy of partially temporally coherent nanoantenna radiation patterns*, Opt. Express **28**, (25), 37844-37859 (2020) **Gold OA**.
8. R.D. Buijs, N.J. Schilder, T.A.W. Wolterink, G. Gerini, E. Verhagen and A.F. Koenderink, *Super-Resolution without Imaging: Library-Based Approaches Using Near-to-Far-Field Transduction by a Nanophotonic Structure*, ACS Photonics **7**, (11), 3246-3256 (2020) **Hybrid OA**.
9. M.M. Sola Garcia, S. Meuret, T. Coenen and A. Polman, *Electron-Induced State Conversion in Diamond NV Centers Measured with Pump–Probe Cathodoluminescence Spectroscopy*, ACS Photonics **7**, (1), 232-240 (2020) **Hybrid OA**.

2021

1. J.S. van der Burgt, D.R. Needell, T. Veeken, A. Polman, E.C. Garnett and H.A. Atwater, *Unlocking Higher Power Efficiencies in Luminescent Solar Concentrators through Anisotropic Lumiphore Emission*, ACS Appl. Mater. Interfaces **13**, (34), 40742-40753 (2021)
2. K.W. Mauser, M. Solà-García, M. Liebrau, B. Damilano, P.-M. Coulon, S. Vézian, P.A. Shields, S. Meuret and A. Polman, *Employing Cathodoluminescence for Nanothermometry and Thermal Transport Measurements in Semiconductor Nanowires*, ACS Nano **15**, (7), 11385-11395 (2021) **Hybrid OA**

3. N. Roosloot, V. Neder, H. Haug, C.C. You, A. Polman and E.S. Marstein, *Broadband angular color stability of dielectric thin film-coated pyramidal textured Si for photovoltaics*, J. Appl. Phys. **129**, (17), 173104: 1-9 (2021)
4. M. Liebtrau, M. Sivis, A. Feist, H. Lourenco-Martins, N. Pazos-Pérez, R.A. Alvarez-Puebla, F.J. García de Abajo, A. Polman and C. Ropers, *Spontaneous and stimulated electron–photon interactions in nanoscale plasmonic near fields*, Light : Sci. Appl. **10**, (1), 82: 1-14 (2021) Gold OA
5. M. Solà-Garcia, K.W. Mauser, M. Liebtrau, T. Coenen, S. Christiansen, S. Meuret and A. Polman, *Photon Statistics of Incoherent Cathodoluminescence with Continuous and Pulsed Electron Beams*, ACS Photonics **8**, (3), 916-925 (2021) Hybrid OA
6. E.C. Garnett, B. Ehrler, A. Polman and E. Alarcón-Lladó, *Photonics for Photovoltaics – advances and opportunities*, ACS Photonics **8**, (1), 61-70 (2021) Hybrid OA

2022

1. E. Akerboom, T. Veeken, C. Hecker, J. van de Groep and A. Polman, *Passive Radiative Cooling of Silicon Solar Modules with Photonic Silica Microcylinders*, ACS Photonics, (2022) Hybrid OA
2. S.W. Tabernig, A.H. Soeriyadi, U. Romer, A. Pusch, D. Lamers, M.K. Juhl, D.N.R. Payne, M.P. Nielsen, A. Polman and N.J. Ekins-Daukes, *Avoiding Shading Losses in Concentrator Photovoltaics Using a Soft-Imprinted Cloaking Geometry*, IEEE J. Photovoltaics **12**, (5), 1116-1127 (2022) Hybrid OA
3. S.W. Tabernig, L. Yuan, C.E.A. Cordaro, Z. Teh, Y. Gao, Robert Patterson, A. Pusch, S. Huang and A. Polman, *Optically Resonant Bulk Heterojunction PbS Quantum Dot Solar Cell*, ACS Nano **16**, (9), 13750-13760 (2022) Hybrid OA
4. L.A. Muscarella, C.E.A. Cordaro, G. Krause, D. Pal, G. Grimaldi, L. S. D. Antony, D. Langhorst, A. Callies, B. Bläsi, O. Höhn, A.F. Koenderink, A. Polman and B. Ehrler, *Nanopatterning of Perovskite Thin Films for Enhanced and Directional Light Emission*, ACS Appl. Mater. Interfaces **14**, (33), 38067-38076 (2022) Hybrid OA
5. Karnieli, D. Roitman, M. Liebtrau, S. Tsesses, N. van Nielen, I. Kaminer, A. Arie and A. Polman, *Cylindrical Metalens for Generation and Focusing of Free-Electron Radiation*, Nano Lett. **22**, (14), 5641-5650 (2022) Hybrid OA
6. S.W. Tabernig, A.H. Soeriyadi, U. Romer, A. Pusch, D. Lamers, M.K. Juhl, D.N.R. Payne, M.P. Nielsen, A. Polman and N.J. Ekins-Daukes, *Avoiding Shading Losses in Concentrator Photovoltaics Using a Soft-Imprinted Cloaking Geometry*, IEEE J. Photovoltaics **12**, (5), 1116–1127 (2022) Hybrid OA
7. Y. Zhang, T. Veeken, S. Wang, G. Scardera, M. Abbott, D.N.R. Payne, A. Polman and B. Hoex, *Plasma Focused Ion Beam Tomography for Accurate Characterization of Black Silicon Validated by Full Wave Optical Simulation*, Adv. Mater. Technol. **7**, (5), 2200068: 1-12 (2022) Hybrid OA
8. T. Veeken, B. Daiber, H. Agrawal, M. Aarts, E. Alarcón-Lladó, E.C. Garnett, B. Ehrler, J. van de Groep and A. Polman, *Directional quantum dot emission by soft-stamping on silicon Mie resonators*, Nanoscale Adv. **4**, (4), 1088-1097 (2022) Gold OA
9. V. Neder, S.W. Tabernig and A. Polman, *Detailed-balance efficiency limits of two-terminal perovskite/silicon tandem solar cells with planar and Lambertian spectral splitters*, J. Photonics Energy **12**, (1), 015502: 1-12 (2022) Hybrid OA
10. Y. Li, S.W. Tabernig, G. Yin, A. Polman and M. Schmid, *Beyond Light-Trapping Benefits: The Effect of SiO₂ Nanoparticles in Bifacial Semitransparent Ultrathin Cu(In,Ga)Se₂ Solar Cells*, Solar RRL **6**, (11), 2200695: 1-8 (2022)

PhD theses

2021

1. V. Neder, *Dielectric metasurfaces for light management in photovoltaics*, University of Amsterdam, March 25, 2021. Promotors: prof. Dr. A. Polman and Prof. Dr. A. Alù OA
2. M. Solà Garcia, *Electron-matter interaction probed with time-resolved cathodoluminescence*, University of Amsterdam, July 9, 2021. Promotor: Prof. Dr. A. Polman, co-promotor Dr. S. Meuret (*cum laude*) AO

2022

1. S.W. Tabernig, *Charge Carrier Generation Management in Photovoltaics*, Promotors: Prof. Dr. A. Polman, Prof. Dr. B. Hoex, co-promotor Dr. E. Alarcón Lladó, University of Amsterdam, 2022-12-08 OA
2. C.E.A. Cordaro, *Metasurfaces for analog optical processing: High-index dielectric metasurfaces performing mathematical operations*, Promotors: Prof. Dr. A. Polman, Prof. Dr. A. Alù, co-promotor Dr. J. van de Groep, University of Amsterdam, 2022-06-02 (*cum laude*) OA
3. T. Veeken, *Photonic control over light absorption and emission in photovoltaics*, University of Amsterdam, Promotor: Prof. Dr. A. Polman, co-promotor Dr. J. van de Groep, 2022-05-11 OA

Master's theses

2017

1. *Spectrum-splitting concepts for parallel-stacked tandem solar cells*
Tom Veeken, University of Amsterdam & VU University Amsterdam (2017)
2. *Broadband light trapping patterns for ultrathin CIGSe and CZTS solar cells*
M. Magda Solà Garcia, University of Amsterdam & VU University Amsterdam (2017)

2018

1. *Determining the resolution of coherent CL and characterization of optical materials*
Joris Schefold, University of Amsterdam & VU University Amsterdam (2018)

2019

1. *All-optical computing metasurfaces*
Andrea Cordaro, Scuola Superiore di Catania (2019)
2. *Directing quantum dot emission in luminescent solar concentrators*
Kyra Orbons, University of Amsterdam & VU University Amsterdam (2019)
3. *Resonant metagratings for spectral and angular control of light in photovoltaics*
Floris Uleman, University of Amsterdam & VU University Amsterdam (2019)

2020

1. *Tailoring vortex cathodoluminescence emission using chiral photon sieves*
Nika van Nielen, University of Amsterdam & VU University Amsterdam (2020)

2021

1. *Energy transfer processes in ytterbium doped metal halide perovskites probed with cathodoluminescence*
Heleen Groenewegen, University of Amsterdam & VU University Amsterdam (2021)
2. *Enhancing passive radiative cooling for solar cells with photonic microstructures*
Evelijn Akerboom, University of Amsterdam & VU University Amsterdam (2021)
3. *Towards using cathodoluminescence for 3D tomography*
Daphne M. Dekker, Utrecht University (2021)

2022

1. *Design and fabrication of optically resonant vanadium dioxide nanocylinders*
Hollie Marks, University of Amsterdam & VU University Amsterdam (2022)
2. *Photon-induced near-field electron microscopy in a scanning electron microscope*
Hannah Niese, ETH Zürich (2022)

Invited lectures at international conferences and meetings

2017

1. *Single-photon time-resolved cathodoluminescence imaging spectroscopy*, A. Polman, NanoMeta, Seefeld, January 4-7, 2017.
2. *Photon bunching with a continuous or a pulsed electron beam*, S. Meuret, KAUST International Electronics 2017, Thuwai, Saudi Arabia, February 6-8, 2017.
3. *Photon bunching in cathodoluminescence spectroscopy*, S. Meuret, French Society for Microscopy Annual Conference, Bordeaux, July 4-7, 2017.
4. *Cathodoluminescence imaging spectroscopy of plasmonic nanostructures*, A. Polman, Summerschool Plasmonics, Porquerolles, September 4-8, 2017.
5. *Autocorrelation function of light under high-energy electron excitation*, S. Meuret 9th Mediterranean conference on nanophotonics, Naples, September 4-5, 2017.
6. *Photon bunching in cathodoluminescence spectroscopy*, S. Meuret, 2nd International workshop Electron beam spectroscopy for nanophotonics, Barcelona, October 25-27, 2017.
7. *Cathodoluminescence imaging spectroscopy of photonic nanostructures (keynote)*, A. Polman, ANZCOP conference, Queenstown, New Zealand, December 4-7, 2017.

2018

1. *Silicon-based optical metasurfaces*, A. Polman, International Conference on Nanoscience and Nanotechnology, Woollongong, Australia, January 29-February 2, 2018
2. *Light management in photovoltaic materials (keynote)*, A. Polman, Energy Futures Symposium, UNSW, Sydney, Australia, February 5-7, 2018
3. *Light management for high-efficiency flexible building- and landscape-integrated PV*, A. Polman, Nanophotovoltaics Symposium, UNSW, Sydney, Australia February 8, 2018
4. *Silicon-based optical metasurfaces*, A. Polman, MRS Spring Meeting, Phoenix, AZ, USA, April 2-6, 2018
5. *Complementary time-resolved cathodoluminescence imaging configurations in scanning electron microscopy*, S. Meuret, Workshop Cathodoluminescence of Semiconductor Nanostructures, Berlin, April 16-17, 2018
6. *Light management and the dream of photovoltaic energy for 0.01 €/kWh*, A. Polman, SPIE Photonics Europe, Strasbourg, France, April 22-26, 2018
7. *Metasurface analog optical computing*, A. Cordaro, SPIE Photonics Europe, Strasbourg, France, April 22-26, 2018
8. *Optical nanoscopy using 30 keV electrons (keynote)*, A. Polman, Swiss Nanoconvention 2018, Zürich, June 6-7, 2018
9. *Optical nanoscopy using 30 keV electrons*, A. Polman, Gordon Research Conference on Plasmonics & Nanophotonics, Newry, ME, USA, July 8-13, 2018
10. *Cathodoluminescence nanoscopy of Au nanostructures*, A. Polman, Gold 2018, Paris, July 15-18, 2018
11. *Time-resolved cathodoluminescence spectroscopy*, S. Meuret, International Microscopy Conference, Sydney, September 10-14, 2018
12. *Time-resolved cathodoluminescence spectroscopy*, S. Meuret, Women in physics conference, Oldenburg, September 28-30, 2018
13. *Optical metasurfaces for advanced PV design*, A. Polman, Workshop Nanophotonics for Solar Energy, Berlin, October 17, 2018
14. *Time-resolved cathodoluminescence spectroscopy*, S. Meuret, Workshop Electron microscopy, MacMaster University, Toronto, Canada, November 12, 2018
15. *Silicon-based optical metasurfaces*, A. Polman, MRS Fall Meeting, Boston, MA, USA, November 25-30, 2018

2019

1. A. Polman, *Light management and the dream of photovoltaic energy for 0.01 €/kWh* (keynote), Next-Gen: IV PV Materials, Groningen, the Netherlands, June 9-12, 2019.
2. A. Polman, *Silicon metasurfaces performing mathematical operations* (keynote), ICMAT 2019, Singapore, June 23-29, 2019.
3. A. Polman, *Photovoltaic Energy: Innovation and scalability to meet climate goals*, International School for Materials for Energy and Sustainability, Caltech, Pasadena, CA, USA, July 21-27, 2019.
4. A. Polman, *Nanoscale (in-)coherent optical excitations in the electron microscope* (plenary), Nanophotonics and Micro/Nano Optics International Conference, Munich, Germany, September 4-6, 2019.
5. A. Polman, *Nanoscale (in-)coherent optical excitations in the electron microscope* (plenary), IEEE-NMDC 2019, Stockholm, Sweden, October 27-30, 2019.
6. V. Neder, *Nano-particle coatings for colored PV*, 14th Conference on Advanced Building Skins, Bern, Switzerland, October 28-29, 2019.

2020

1. S. Meuret, Time-resolved cathodoluminescence: from lifetime measurements to pump-probe luminescence spectroscopy, Australian Conference on Microscopy and Microanalysis, Canberra, Australia, February 18, 2020.
2. A. Cordaro, Nano-patterned back-reflector for III–V-on-silicon solar cells, SPIE Photonics Europe, Strasbourg, March 29 - April 2, 2020 – online.
3. T. Veeken, Strong directional CdSe/ZnS core-shell quantum dot emission for Si/tetracene singlet-triplet down-conversion photovoltaics, SPIE Photonics Europe, Strasbourg, March 29 - April 2, 2020 – online.
4. A. Polman, Controlling directional emission in advanced PV design (keynote), NanoMatEn2020, Paris, June 24-26, 2020 – cancelled.
5. A. Polman, Nanoscale (in-)coherent optical excitations in the electron microscope, International conference on near-field optics, Victoria, Canada, August 17-21, 2020 – cancelled.
6. A. Polman, Cathodoluminescence holography, Nanophotonics symposium, Cetraro, Italy, 27-29 August 2020 – cancelled.
7. A. Polman, Nanoscale (in-)coherent optical excitations in the electron microscope, 14th International Congress on Artificial Materials for Novel Wave Phenomena, New York, USA, September 28 - October 1, 2020 – online.
8. A. Polman, Controlling directional emission in advanced PV design, Third European workshop on optics for solar energy, Berlin, October 7-8, 2020 – online.
9. A. Polman, Nanoscale (in-)coherent optical excitations in the electron microscope, International conference on near-field optics, MRS Singapore, Singapore, November 25-27, 2020 – online
10. A. Polman, Nanoscale (in-)coherent optical excitations in the electron microscope, MRS Fall Meeting, Boston, November 29 – December 3, 2020 – online.
11. V. Neder, F. Uleman, A. Cordaro, A. Polman, Spectrum splitting and directivity control by optical metasurfaces integrated in photovoltaic devices, SPIE Photonics Strasbourg 2020, Strasbourg, France – online.
12. A. Cordaro, OSA Imaging and Applied Optics Congress, Vancouver, June 2020

2021

1. A. Polman, *Towards quantum electron wavepacket spectroscopy*, Q-Sort workshop (online), 1-3/09/2021.
2. A. Polman, *Nanoscale coherent optical excitations in the scanning electron microscope*, 12th Meeting on Nanoscience Advances, Porquerolles, 13-15/09/2021.
3. A. Polman, *Nanoscale coherent optical excitations in the scanning electron microscope*, 5th Workshop on applications on dielectric laser accelerators, Erlangen, 27/11/2021.

2022

1. A. Polman, *Holography, nanothermometry, and quantum correlations in extreme near fields probed with high-energy electrons*, NanoMeta, January 6-9, 2021
2. A. Polman, *Optical metasurfaces for analog optical computing and improved photovoltaics*, EPS Symposium on the Third Generation Metamaterials, Cetraro, Italy, August 1-5, 2022
3. A. Polman, *Nanoscale (in-)coherent optical excitations in the electron microscope*, International conference on near-field optics, Victoria, Canada, August 29 – September 2, 2022
4. A. Cordaro, *Optical metamaterials performing mathematical operations*, META, Sienna, September 12-16, 2022
5. A. Polman, *Probing optical near fields with high-energy electrons: holography, topological crystals and quantum correlations*, KAST Workshop, Paris, October 24-25, 2022

Awards & recognitions

2017

1. A. Polman, Research into the Science of Light Prize, European Physical Society
2. A. Polman, Frew Fellowship, Australian Academy of Sciences
3. A. Polman, Highly cited researcher (Clarivate, Web of Science).
4. V. Neder, SolarPower R&D Award, Angel Business Communications
5. T.P.N. Veeken, Best Scientific Poster Prize, Sunday Dutch Solar Conference 2017, Bussum, the Netherlands, 8 November, 2017

2018

1. A. Polman, Highly cited researcher (Clarivate, Web of Science).
2. T.P.N. Veeken, QHQC Award, Quantsol International Photovoltaics Summer School, Hirschegg, Austria, September 9, 2018.

2019

1. A. Polman, Highly cited researcher (Clarivate, Web of Science).

2020

1. A. Cordaro, Premio Brovotto, Italian Physical Society.

2021

1. A. Polman, ERC Advanced Investigator Grant
2. M. Sola Garcia, *Cum laude* PhD Award, University of Amsterdam
3. S.W. Tabernig, Best Presentation Award, 31st International Photovoltaic Science and Engineering Conference (PVSEC-31), Sydney, NSW, Australia, 13–15/12/2021.
4. S.W. Tabernig, Best Presentation Award, MRS Fall Meeting and Exhibit, Boston, MA, USA, 29/11–02/12/2021.

2022

1. A. Cordaro, *Cum laude* PhD Award, University of Amsterdam
2. A. Cordaro, Rising Stars of Light Award, Light, Science and Applications, 2022
3. N. van Nielen, Poster prize NanoMeta, Seefeld, Austria, March 2022

Academic teaching

2017

1. Master's course Photovoltaics in master's program Advanced Materials and Energy Physics (AMEP), University of Amsterdam

2018

1. Master's course Photovoltaics in master's program Advanced Materials and Energy Physics (AMEP), University of Amsterdam

2019

1. Master's course Photovoltaics in master's program Advanced Materials and Energy Physics (AMEP), University of Amsterdam

2020

1. Master's course Photovoltaics in master's program Advanced Materials and Energy Physics (AMEP), University of Amsterdam

2021

1. Master's course Photovoltaics in master's program Advanced Materials and Energy Physics (AMEP), University of Amsterdam

2022

1. Master's course Photovoltaics in master's program Advanced Materials and Energy Physics (AMEP), University of Amsterdam

Economic valorization

1. Establishment of National Agenda Materials – Accelerating Materials Technology, followed by application and granting by the National Growth Fund of the research, technology and industrial development program *Sustainable MaterialsNL*. Granted programs are: Circular plastics (2022, total budget 532 M€), Photovoltaics (2023, 898 M€), Batteries (2023, 822 M€) and Sustainable steel (2023, 177 M€). Total subsidy granted 952 M€, private investors contribute 1477 M€.
2. Electron microscopy: Research contract with Delmic B.V, Delft:
 - Development of SEM-based cathodoluminescence imaging spectroscopy (spectral, angle-, polarization- and time-resolved). New products (SPARC, SPARC Compact, Jolt, LabCube, light incoupling unit) brought on the market by Delmic, products sold to nearly 100 customers worldwide so far (since 2016)
3. Electron microscopy: Research contract with ThermoFischer/FEI:
 - Development of electrostatic beam blanker for time-resolved scanning electron microscopy: product sold to many customers worldwide (since 2018)
 - Development of photo-emission scanning electron microscope (with Delmic laser and optics): product sold to initial customers (since 2022)The total sales of products by Delmic and ThermoFischer based on demonstrators developed at AMOLF is multiple million euro/year, the added value to the Dutch economy is multiple million euro/year.
4. Research collaboration with SCIL Imprint Solutions (Philips Group Innovation) on soft imprint lithography: application studies at AMOLF in photovoltaics, metasurfaces, LEDs assist SCIL in exploring markets.
5. Research contract with Shell, BASF, ExxonMobil, Toyota, Delmic, DENSSolutions on light-driven chemistry: knowledge transfer through workshops
6. Research contract with TNO, VDL, SALDtech, HyET Solar, Delmic to develop roll-to-roll perovskite solar cells: knowledge transfer through workshops
7. Research contract with WITech and Delmic on metasurfaces for analog optical processing: knowledge transfer through workshops
8. Technical presentations through webinars (Delmic), at companies (Applied Materials), technical journal (Microscopy and Microanalysis).
9. Patent application: *Method and apparatus for the determination of thermal properties of a measurement area of a sample*, K.W. Mauser and A. Polman, Dutch patent application, #2027219, granted (2020)
10. Patent application: *A solar energy harvesting device based on zinc and phosphorous compounds as absorber*, M. Dimitrievska, S. Tabernig, A. Polman, and A. Fontcuberta I Morral, under review (2021)