Dr Simon Kahmann

Chemnitz University of Technology
Institute of Physics
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07/07/2023

Research focus: Functional materials for optoelectronics
My research connects the synthesis of novel semiconductors with their eventual application in optoelectronic devices. The core aim is to understand and to exploit the impact of nano-sized tailoring and chemical modification on the photophysical properties of materials processed from solution.

EDUCATION & DEGREES

Double Doctorate in Materials Physics/Materials Science, with distinction (1.0)[1] 2018
University of Groningen, The Netherlands
Friedrich-Alexander University Erlangen-Nuremberg, Germany
Advisors: Prof. Dr. Maria A. Loi, Prof. Dr. Christoph J. Brabec

Master of Science in Nanotechnology, with distinction (1.1) 2013
Friedrich-Alexander University Erlangen-Nuremberg, Germany

Bachelor of Engineering in Microtechnology, very good (1.5) 2011
University of Applied Sciences Zwickau, Germany

PROFESSIONAL EXPERIENCE

Tenure Track Assistant Professor in Experimental Semiconductor Physics since 2023
(Juniorprofessur, W1 nach W2), Chemnitz University of Technology, Germany

Early Career Fellow, Junior PI 2022-2023
Department of Chemical Engineering and Biotechnology, University of Cambridge, United Kingdom

Research Fellow, Senior Postdoc 2021-2022
Cavendish Laboratory & Department of Chemical Engineering and Biotechnology, University of Cambridge, United Kingdom

DFG Research Fellow, Senior Postdoc 2019-2020
Zernike Institute for Advanced Materials, Groningen, The Netherlands

Research Associate, Postdoc 2018
Zernike Institute for Advanced Materials, Groningen, The Netherlands

Research Assistant, PhD student 2014-2017
Institute of Materials for Electronics and Energy Technology, Erlangen, Germany
Zernike Institute for Advanced Materials, Groningen, The Netherlands

HONOURS & FUNDING

Emerging Investigator Award Journal of Materials Chemistry C 2023

Early Career Fellowship *Hybrid nanostructures for chiral optoelectronics – polarising communication* (ECF-2022-593), Leverhulme Trust, United Kingdom; 118000 £ 2022

Matching funding for Leverhulme ECF Isaac Newton Trust, Cambridge, United Kingdom (22.08(i)); 50000 £ 2022

College Research Associate Sidney Sussex College, Cambridge 2021

Postdoctoral Fellowship *Spatio-temporal spectroscopy for characterising perovskite solar cells incorporating low-dimensional structures*, German Academic Exchange Service (DAAD) (91793256), short-term programme (6 months); 18704 € 2021

[1] German grading system: 1.0 is the best grade, below 4.0 counts as failed.

Postdoctoral Fellowship *Hot charge carriers in tin-based perovskite solar cells to exceed the Shockley-Queisser limit* (408012143), German Research Foundation (DFG); 66951 € — 2019

Research Grant, "Hot-carrier extraction in tin-based perovskite solar cells to exceed the Shockley-Queisser limit" funded by the Dutch Research Council (NWO) (739.017.005) — 2018
Grant design and participation in submission in the name of Prof. M. A. Loi
Funding volume 325095 €

Membership of graduate college 1896 "In situ Microscopy with Electrons, X-rays and Scanning Probes" of the Deutsche Forschungsgemeinschaft, Erlangen, Germany — 2016-2017

Poster Award, Next Generation OPV II conference, Groningen, The Netherlands — 2015

Doctoral Scholarship, Ubbo Emmius Foundation, University of Groningen, The Netherlands — 2014-2015

Thesis Award for best bachelor's thesis 2011, Mentor e. V., Zwickau, Germany — 2013

Student Scholarship, Friedrich Ebert Foundation, Bonn, Germany — 2012-2013

Student Scholarship, Erasmus Programme of the European Union — 2012

ACADEMIC VISITS & INTERNATIONAL EXPERIENCE

Visiting researcher in the group Prof. Sam Stranks University of Cambridge — since 2023

Visiting researcher in the group of Prof. Andrea Mura, University of Cagliari, Italy — 2019

Visiting researcher in the group of Prof. Andrea Mura, University of Cagliari, Italy — 2017

Undergraduate studies at the University of Linköping, Sweden — 2012

TEACHING EXPERIENCE

COURSES

Assistant lecturer in "Nanophysics", undergraduate level, Groningen — 2019

Teaching assistant in "Nanophysics", undergraduate level, Groningen — 2017-2018

Lab course supervisor "Optical, Electrical and Magnetic Properties of Materials", undergraduate level, Erlangen — 2015

DOCTORAL PROJECTS

Co-supervisor Shenyu Nie, Cambridge — since 2023

Daily advisor Barnaby Lewis, Cambridge — since 2021

Daily advisor Alan Baldwin, Cambridge — 2021-2023

Daily advisor Eelco K Tekelenburg, Groningen — 2019-2021

STUDENT THESES

Daily advisor for student theses 2 master's projects, 2 bachelor's projects, 3 internships/visits — 2014-2023

CONFERENCES & SEMINARS

ORGANISATION

Next Generation Solar Energy PhD/Postdoc Series — since 2022
Co-organiser of a bi-weekly seminar series for emerging researchers in the field of materials science and renewable energy
https://www.ngse.info/phd-postdoc-series

2D Perovskites: Synthesis, Properties, and Applications — 2023
Symposium co-organisation at the MATSUS23 Spring Meeting, Valencia, Spain

Two-Dimensional Perovskites - Fundamentals, Applications, and Perspectives — 2021
Symposium co-organisation at the NanoGe Spring Meeting, online

CONTRIBUTIONS

In total, I have attended 26 scientific conferences and seminars contributing 16 oral presentations (6

invited) and 8 posters.

Luminescence in 2D perovskites – on trapping and self-trapping 2022
Emerging Light Emitting Materials 22, Limassol, Cyprus (oral)

Beware of the local effects – 2D perovskites under the microscope 2022
NanoGe Strain and 2D Perovskites (S2DP) seminar, online (**invited**)

Luminescence in 2D perovskites – on trapping and self-trapping 2022
Centre for Processable Electronics Annual Symposium *Imperial College, London, United Kingdom*, (**invited**)

Taking a closer look: the power of optical microscopy to unravel the complex world of two-dimensional perovskites 2022
Seminar talk in *Next Generation Solar Energy, PhD-postdoc series*, online (**invited**)

Hot, Bright, and Trapped States: Luminescence of Two-Dimensional Perovskites and Lessons Learnt from Photoluminescence Microsocpy 2021
Seminar talk in *Optoelectronics of Halide Perovskites* series, University of Bayreuth, Germany (**invited**)

Broad Emission Bands in Two-Dimensional Perovskites and the Role of Exciton Self-Trapping 2021
NanoGe Fall Meeting, online (oral)

Hot, bound, and defect states – exploring the rich photophysics of two-dimensional perovskites 2020
Seminar Talk Photonics and Optoelectronics Lab, University of Cagliari, Italy (**invited**)

Photoluminescence spectroscopy of perovskites – beyond 3D lead variants 2020
Seminar Talk for PVsquared group, University of Pavia, Italy (**invited**)

On the origin of broad luminescence bands in low-dimensional perovskites
NanoGe International Conference on Perovskite Solar Cells, Photonics and Optoelectronics (NIPHO20), Seville, Spain (oral)

The remarkable physics of tin halide perovskites: on hot states and dark states 2019
13^{th} International Conference on Optical Probes for Organic and Hybrid Optoelectronic Materials and Applications, Vilnius, Lithuania (oral)

The remarkable physics of tin halide perovskites: on hot states and dark states 2019
10^{th} International Conference on Materials for Advanced Technologies, Singapore, Singapore (oral)

The remarkable physics of tin halide perovskites: on hot states and dark states 2019
Next Generation Photovotlaic Materials IV, Groningen, The Netherlands (oral)

The photophysics of FASnI$_3$ thin films how processing affects hot carriers, scattering mechanisms and long-lived states 2019
3^{rd} Generation Photovoltaic Technologies and Beyond, King Abdullah University, Saudi Arabia, (poster)

Photophysics of formamidinium lead:tin iodide perovskite thin films 2018
Gordon Research Conference on Electronic Processes in Organic Materials, Barga, Italy, (poster)

Trap states in lead sulphide colloidal quantum dots investigated through photoinduced absorption spectroscopy 2018
Gordon Research Conference on Colloidal Semiconductor Nanocrystals, Boston, United States of America, (poster)

Trap states in lead sulphide colloidal quantum dots investigated via photoinduced absorption spectroscopy 2017
Next Generation Photovoltaic Materials III, Groningen, The Netherlands (oral)

Excited state interaction in polymer wrapped single walled carbon nanotubes 2017
12^{th} International Conference on Optical Probes for Organic and Hybrid Optoelectronic Materials and Applications, Quebec City, Canada (oral)

Polarons in narrow band gap polymers probed over the entire infrared spectral range 2016
Next Generation Solar Energy Meets Nanotechnology, Erlangen, Germany (poster)

Ultrafast energy transfer boosts the performance of a ternary organic solar cell approaching 10% efficiency 2016
Condensed Matter Division of the EPS, Groningen, The Netherlands (oral)

Lead sulphide quantum dot solar cells by blade coating from hybrid organic-inorganic solutions 2015
Next Generation Organic Photovoltaics II, Groningen, The Netherlands (poster)

Hybrid organic-inorganic blends comprising lead sulphide quantum dots for solar cell applications 2015
Gordon Research Seminar & Conference on Nanomaterials for Energy Applications, Ventura, United States of America (poster)

Hybrid solar cells using PbS quantum dots and a narrow-bandgap polymer 2015
Physics @ FOM, Veldhoven, The Netherlands (poster)

Hybrid solar cells using PbS quantum dots and a narrow-bandgap polymer 2014
Ameland Summer School, Ameland, The Netherlands (poster)

Hybrid solar cells using PbS quantum dots and narrow-bandgap polymers 2014
EMRS Spring Conference, Lille, France (oral)

PROFESSIONAL SERVICES & OUTREACH

Peer-reviewer including for *ACS Nano*, *Advanced Functional Materials*, *Advanced Materials*, *Joule*, *Journal of American Chemical Society*, *Journal of Physical Chemistry Letters*, *Science Advances*

German Physical Society (DPG) Member since 2022

External reviewer for Feodor-Lynen scholarships for Alexander von Humboldt Foundation since 2021

Mentor for students in the natural sciences Friedrich-Ebert Foundation, Bonn, Germany since 2021

Laser Safety Officer Department of Chemical Engineering and Biotechnology, University of Cambridge 2022-2023

Outreach Presentation *Lead sulphide colloidal quantum dots* for "Francken" student association, Groningen, The Netherlands 2018

Outrech Presentation *Electrical power from the sun* as a part of university lecture series *Studium Generale*, Zwickau, Germany 2011

PROFESSIONAL DEVELOPMENT

Supervising Postgraduate Research Students Workshop, University of Cambridge 2022

Introduction to Undergraduate Supervision Online-workshop, University of Cambridge 2021

Negotiation and Influencing Skills Online-workshop, University of Cambridge 2021

Collaboration in Research Online-workshop, University of Cambridge 2021

Relationships & Teams Online-workshop, University of Cambridge 2021

Scientific Proposals with Impact Seminar, University of Groningen 2018

Career Planning in Science Seminar, University of Groningen 2016

Academic Writing in English Seminar, University of Erlangen-Nuremberg 2015

Scientific Presentation Skills Seminar, University of Groningen 2014

LANGUAGE EXPERIENCE

German (native), **English** (fluent), **Dutch** (basic) **French** (basic), **Swedish** (basic)

REFERENCES

Prof. Dr Samuel D. Stranks
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University of Cambridge
JJ Thomson Avenue, CB30HE Cambridge, United Kingdom
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Prof. Dr Maria A. Loi
Zernike Institute of Advanced Materials (ZIAM)
University of Groningen
Nijenborgh 4, 9747 AG Groningen, The Netherlands
m.a.loi@rug.nl; +3150 3634119

Prof. Dr Christoph J. Brabec
Institute for Materials in Electronics and Energy Technology (iMEET)
Friedrich-Alexander University Erlangen-Nuremberg
Martensstraße 7, 91058 Erlangen, Germany
christoph.brabec@fau.de; +499131 8525426

PUBLICATIONS

Currently, 44 published reports in international peer-reviewed journals, 17 of which as first author, accumulate a total of 1451 citations with a Hirsch index of 22 and an i10 index of 29 (Google scholar). * Denotes corresponding authorship.

PUBLISHED

1. M. Rivera Medina, L. Di Mario, S. Kahmann, J. Xi, , G. Portale, G. Bongiovanni, A. Mura, J. C. Alonso-Hutron, M. A. Loi, Tuning the energy transfer in ruddlesden-popper perovskites phases through isopropylammonium addition - towards efficient blue emitters, *Nanoscale* (2023), DOI: 10.1039/D3NR00087G
2. H.-H. Fang, E. K. Tekelenburg, H. Xue, S. Kahmann, L. Chen, S. Adjokatse, G. Brocks, S. Tao, M. A. Loi, Unraveling the Broadband Emission in mixed Tin-Lead Layered Perovskites, *Adv. Opt. Mater.* 2202038, (2022)
3. *S. Kahmann, H. Duim, A. J. Rommens, K. Frohna, G. H. ten Bring, G. Portale, S. D. Stranks, M. A. Loi, Taking a closer look how the microstructure of Dion-Jacobson perovskites governs their photophysics, *J. Mater. Chem. C* 10, 17539 (2022). *2023 Emerging Investigators & 2022 JMCC Most Popular Articles*
4. *S. Kahmann, D. Meggiolaro, L. Gregori, E. K. Tekelenburg, M. Pitaro, S. D. Stranks, F. De Angelis, M. A. Loi, The origin of broad emission in <100> two-dimensional perovskites: Extrinsic vs. intrinsic processes, *ACS Energy Letters* 7, 4232 (2022)
5. O. D. I. Moseley, B. Roose, S. J. Zelewski, S. Kahmann, K. Dey, S. D. Stranks, Tunable multiband halide perovskite tandem photodetectors with switchable response, *ACS Photonics* (2022)
6. C. Cho, S. Feldmann, K. M. Yeom, Y.-W. Jang, S. Kahmann, J.-Y. Huang, T. C.-J. Yang, M. N. T. Khayyat, Y.-R. Wu, M. Choi, J. H. Noh, S. D. Stranks, N. C. Greenham, Efficient vertical charge transport in polycrystalline halide perovskites revealed by four-dimensional tracking of charge carriers, *Nature Materials* (2022)
7. S. Kahmann, Z. Chen, O. Hordiichuk, O. Nazarenko, S. Shao, M. V. Kovalenko, G. R. Blake, S. Tao, M. A. Loi, Compositional Variation in $FAPb_{1-x}Sn_xI_3$ and Its Impact on the Electronic Structure: A Combined Density Functional Theory and Experimental Study, *ACS Appl. Mater. Interfaces* 14, 34253 (2022)

8. D. Bederak, A. Shulga, S. Kahmann, W. Talsma, J. Pelanskis, D. N. Dirin, M. V. Kovalenko, M. A. Loi, Heterostructure from PbS Quantum Dot and Carbon Nanotube Inks for High-Efficiency Near-Infrared Light-Emitting Field-Effect Transistors, *Adv. Electron. Mater.* 2101126, (2022)
9. J. Warby, F. Zu, S. Zeiske, E. Gutierrez-Partida, L. Frohloff, S. Kahmann, K. Frohna, E. Mosconi, E. Radicchi, F. Lang, S. Shah, F. Peña-Camargo, H. Hempel, T. Unold, N. Koch, A. Armin, F. De Angelis, S. D. Stranks, D. Neher, M. Stolterfoht, Understanding Performance Limiting Interfacial Recombination in *pin* Perovskite Solar Cells, *Adv. Energy Mater.* 12, 2103567 (2022)
10. *S. Kahmann, H. Duim, A. J. Rommens, E. K. Tekelenburg, S. Shao, M. A. Loi, Grain-Specific Transitions Determine the Band Edge Luminescence in DionJacobson Type 2D Perovskites, *Adv. Opt. Mater.* 9, 2100892 (2021)
11. S. Kahmann, H. Duim, H.-H. Fang, M. Dyksik, S. Adjokatse, M. Rivera Medina, M. Pitaro, P. Plochocka, M. A. Loi, Photophysics of Two-Dimensional Perovskites – Learning from Metal Halide Substitution, *Adv. Funct. Mater.* 31, 2103778 (2021)
12. J. Liu, B. Van der Zee, D. R. Villava, G. Ye, S. Kahmann, M. Kamperman, J. Dong, L. Qiu, G. Portale, M. A. Loi, J. C. Hummelen, R. C. Chiechi, D. Baran, L. J. A. Koster, Molecular Doping Directed by a Neutral Radical, *ACS Appl. Mater. Interfaces* 13, 29858 (2021)
13. A. Filippetti, S. Kahmann, C. Caddeo, A. Mattoni, M. Saba, A. Bosin, M. A. Loi, Fundamentals of tin iodide perovskites: a promising route to highly efficient, lead-free solar cells, *J. Mater. Chem. A* 9, 11812 (2021)
14. S. Shao, W. Talsma, M. Pitaro, J. Dong, S. Kahmann, A. J. Rommens, G. Portale, M. A. Loi, Field-Effect Transistors Based on Formamidinium Tin Triiodide Perovskite, *Adv. Funct. Mater.* 31, 2008478 (2021)
15. E. K. Tekelenburg, S. Kahmann, M. E. Kamminga, G. R. Blake, M. A. Loi, Elucidating the Structure and Photophysics of Layered Perovskites through Cation Fluorination, *Adv. Opt. Mater.* 9, 2001647 (2021)
16. S. Shao, M. Nijenhuis, J. Dong, S. Kahmann, G. H. ten Brink, G. Portale, M. A. Loi, Influence of the stoichiometry of tin-based 2D/3D perovskite active layers on solar cell performance, *J. Mater. Chem. A* 9, 10095 (2021)
17. D. Bederak, N. Sukharevska, S. Kahmann, M. Abdu-Aguye, H. Duim, D. N. Dirin, M. V. Kovalenko, G. Portale, M. A. Loi, On the Colloidal Stability of PbS Quantum Dots Capped with Methylammonium Lead Iodide Ligands, *ACS Appl. Mater. Interfaces* 12, 52959 (2020)
18. S. Kahmann, M. A. Loi, Trap states in lead chalcogenide colloidal quantum dots – origin, impact, and remedies, *Appl. Phys. Rev.* 7, 041305 (2020)
19. B. G. H. M. Groeneveld, H. Duim, S. Kahmann, O. De Luca, E. K. Tekelenburg, M. E. Kamminga, L. Protesescu, G. Portale, G. R. Blake, P. Rudolf, M. A. Loi, Photochromism in Ruddlesden-Popper copper-based perovskites: a light-induced change of coordination number at the surface, *J. Mater. Chem. C* 8, 15377 (2020)
20. S. Kahmann, O. Nazarenko, S. Shao, O. Hordiichuk, M. Kepenekian, J. Even, M. V. Kovalenko, G. R. Blake, M. A. Loi, Negative Thermal Quenching in $FASnI_3$ Perovskite Single Crystals and Thin Films, *ACS Energy Lett.* 5, 2512 (2020)
21. S. Kahmann, E. K. Tekelenburg, H. Duim, M. E. Kamminga, M. A. Loi, Extrinsic nature of the broad photoluminescence in lead iodide-based Ruddlesden-Popper perovskites, *Nat. Commun.* 11, 2344 (2020)
22. J. Dong, S. Shao, S. Kahmann, A. J. Rommens, D. Hermida-Merino, G. H. ten Brink, M. A. Loi, G. Portale, Mechanism of Crystal Formation in Ruddlesden-Popper Sn-Based Perovskites, *Adv. Funct. Mater.* 30, 2001294 (2020)
23. I. van de Riet, H.-H. Fang, S. Adjokatse, S. Kahmann, M. A. Loi, Influence of morphology on photoluminescence properties of methylammonium lead tribromide films, *J. Lumin.* 220, 117033 (2020)
24. M. Abdu-Aguye, D. Bederak, S. Kahmann, N. Killilea, M. Sytnyk, W. Heiss, M. A. Loi, Photophysical and electronic properties of bismuth-perovskite shelled lead sulfide quantum dots, *J. Chem. Phys.* 151, 214702 (2019)

25. G. Demirel, R. L. M. Gieseking, R. Ozdemir, S. Kahmann, M. A. Loi, G. C. Schatz, A. Facchetti, H. Usta, Molecular engineering of organic semiconductors enables noble metal-comparable SERS enhancement and sensitivity, *Nat. Commun.* 10, 5502 (2019)
26. H. Duim, S. Adjokatse, S. Kahmann, G. H. ten Brink, M. A. Loi, The Impact of Stoichiometry on the Photophysical Properties of Ruddlesden-Popper Perovskites, *Adv. Funct. Mater.* 30, 1907505 (2020)
27. R. Sun, J. Guo, Q. Wu, Z. Zhang, W. Yang, J. Guo, M. Shi, Y. Zhang, S. Kahmann, L. Ye, X. Jiao, M. A. Loi, Q. Shen, H. Ade, W. Tang, C. J. Brabec, J. Min, A multi-objective optimization-based layer-by-layer blade-coating approach for organic solar cells: rational control of vertical stratification for high performance, *Energy Environ. Sci.* 12, 3118 (2019)
28. S. Kahmann, A. Shulga, M. A. Loi, Quantum Dot Light-Emitting Transistors – Powerful Research Tools and Their Future Applications, *Adv. Funct. Mater.* 30, 1904174 (2020)
29. S. Kahmann, S. Shao, M. A. Loi, Cooling, Scattering, and Recombination – The Role of the Material Quality for the Physics of Tin Halide Perovskites, *Adv. Funct. Mater.* 29, 1902963 (2019)
30. S. Adjokatse, S. Kahmann, H. Duim, M. A. Loi, Effects of strontium doping on the morphological, structural, and photophysical properties of $FASnI_3$ perovskite thin films, *APL Materials* 7, 031116 (2019)
31. N. Gasparini, S. Kahmann, M. Salvador, J. D. Perea, A. Sperlich, A. Baumann, N. Li, S. Rechberger, E. Spiecker, V. Dyakonov, G. Portale, M. A. Loi, C. J. Brabec, T. Ameri, Favorable Mixing Thermodynamics in Ternary Polymer Blends for Realizing High Efficiency Plastic Solar Cells, *Adv. Energy Mater.* 9, 1803394 (2019)
32. S. Kahmann, M. A. Loi, Hot carrier solar cells and the potential of perovskites for breaking the Shockley-Queisser limit, *J. Mater. Chem. C* 7, 2471 (2019)
33. A. Classen, L. Einsiedler, T. Heumueller, A. Graf, M. Brohmann, F. Berger, S. Kahmann, M. Richter, G. J. Matt, K. Forberich, J. Zaumseil, C. J. Brabec, Absence of Charge Transfer State Enables Very Low V_{OC} Losses in SWCNT:Fullerene Solar Cells, *Adv. Energy Mater.* 9, 1801913 (2019)
34. A. G. Shulga, S. Kahmann, D. N. Dirin, A. Graf, J. Zaumseil, M. V. Kovalenko, M. A. Loi, Electroluminescence Generation in PbS Quantum Dot Light-Emitting Field-Effect Transistors with Solid-State Gating, *ACS Nano* 12, 12805 (2018)
35. S. Kahmann, W. Gomulya, M. A. Loi, A. Mura, Donor-acceptor photoexcitation dynamics in organic blends investigated with a high sensitivity pumpprobe system, *J. Mater. Chem. C* 6, 10822 (2018)
36. S. Kahmann, M. A. Loi, C. J. Brabec, Delocalisation softens polaron electronic transitions and vibrational modes in conjugated polymers, *J. Mater. Chem. C* 6, 6008 (2018)
37. S. Kahmann, M. Sytnyk, N. Schrenker, G. J. Matt, E. Spiecker, W. Heiss, C. J. Brabec, M. A. Loi, Revealing Trap States in Lead Sulphide Colloidal Quantum Dots by Photoinduced Absorption Spectroscopy, *Adv. Electron. Mater.* 4, 1700348 (2018)
38. S. Kahmann, J. M. Salazar Rios, M. Zink, S. Allard, U. Scherf, M. C. dos Santos, C. J. Brabec, M. A. Loi, Excited-State Interaction of Semiconducting Single-Walled Carbon Nanotubes with Their Wrapping Polymers, *J. Phys. Chem. Lett.* 8, 5666 (2017)
39. S. Kahmann, D. Fazzi, G. J. Matt, W. Thiel, M. A. Loi, C. J. Brabec, Polarons in Narrow Band Gap Polymers Probed over the Entire Infrared Range: A Joint Experimental and Theoretical Investigation, *J. Phys. Chem. Lett.* 7, 4438 (2016)
40. S. Chen, Y. Hou, H. Chen, M. Richter, F. Guo, S. Kahmann, X. Tang, T. Stubhan, H. Zhang, N. Li, N. Gasparini, C. O. R. Quiroz, L. S. Khanzada, G. J. Matt, A. Osvet, C. J. Brabec, Exploring the Limiting Open-Circuit Voltage and the Voltage Loss Mechanism in Planar $CH_3NH_3PbBr_3$ Perovskite Solar Cells, *Adv. Energy Mater.* 6, 1600132 (2016)
41. X. Tang, M. Brandl, B. May, I. Levchuk, Y. Hou, M. Richter, H. Chen, S. Chen, S. Kahmann, A. Osvet, F. Maier, H.-P. Steinrck, R. Hock, G. J. Matt, C. J. Brabec, Photoinduced degradation of methylammonium lead triiodide perovskite semiconductors, *J. Mater. Chem. A* 4, 15896 (2016)

42. H. Chen, Y. Hou, C. E. Halbig, S. Chen, H. Zhang, N. Li, F. Guo, X. Tang, N. Gasparini, I. Levchuk, S. Kahmann, C. O. Ramirez Quiroz, A. Osvet, S. Eigler, C. J. Brabec, Extending the environmental lifetime of unpackaged perovskite solar cells through interfacial design, *J. Mater. Chem. A* 4, 11604 (2016)
43. S. Kahmann, A. Mura, L. Protesescu, M. V. Kovalenko, C. J. Brabec, M. A. Loi, Opto-electronics of PbS quantum dot and narrow bandgap polymer blends, *J. Mater. Chem. C* 3, 5499 (2015)
44. B. Beyer, D. Griese, C. Schirrmann, R. Pfeifer, S. Kahmann, O. R. Hild, K. Leo, Small molecule bulk heterojunction organic solar cells with coumarin-6 as donor material, *Thin Solid Films* 536, 206 (2013)