

List of publications Prof. Dr. Thomas Kirchartz:

Books (as editor):

D. Abou-Ras, T. Kirchartz, and U. Rau (Eds.) *Advanced Characterization Techniques for Thin Film Solar Cells*, Wiley-VCH, 2011, ISBN:9783527410033

Book chapters:

1. T. Kirchartz and U. Rau, *Introduction to Thin-Film Photovoltaics*, in *Advanced Characterization Techniques for Thin Film Solar Cells*, Wiley-VCH, 2011
2. T. Kirchartz, K. Ding and U. Rau, *Fundamental Electrical Characterization of Thin-Film Solar Cells*, in *Advanced Characterization Techniques for Thin Film Solar Cells*, Wiley-VCH, 2011
3. T. Kirchartz, A. Helbig, B. E. Pieters, and U. Rau, *Electroluminescence Analysis of Solar Cells and Solar Modules*, in *Advanced Characterization Techniques for Thin Film Solar Cells*, Wiley-VCH, 2011
4. B. E. Pieters, K. Decock, M. Burgelman, R. Stangl, and T. Kirchartz, *One-Dimensional Electro-Optical Simulations of Thin-Film Solar Cells*, in *Advanced Characterization Techniques for Thin Film Solar Cells*, Wiley-VCH, 2011
5. M. Peters, A. Bielawny, B. Bläsi, R. Carius, S. W. Glunz, J. C. Goldschmidt, H. Hauser, M. Hermle, T. Kirchartz, P. Löper, J. Üpping, R. Wehrspohn, and G. Willeke, *Photonic concepts for solar cells* in V. Badescu and M. Paulescu (Eds.) *Physics of nanostructured solar cells*, Nova Science, New York, 2010

peer reviewed articles:

2006

1. P. J. Rostan, U. Rau, V. X. Nguyen, T. Kirchartz, M. B. Schubert, and J. H. Werner, *Low-temperature a-Si:H/ZnO/Al back contacts for high-efficiency silicon solar cells*, *Sol. Energy Mater. Sol. Cells* **90**, 1345 (2006)

2007

2. T. Kirchartz, U. Rau, M. Kurth, J. Mattheis, and J. H. Werner, *Comparative study of electroluminescence from Cu(In,Ga)Se₂ and Si solar cells*, *Thin Solid Films* **515**, 6238 (2007)
3. T. Kirchartz, J. Mattheis, and U. Rau, *Electroluminescence from Cu(In,Ga)Se₂ thin-film solar cells*, *Mater. Res. Soc. Symp. Proc.* **1012**, 115 (2007)
4. T. Kirchartz and U. Rau, *Electroluminescence analysis of high efficiency Cu(In,Ga)Se₂ solar cells*, *J. Appl. Phys.* **102**, 104510 (2007)

2008

5. T. Kirchartz, U. Rau, M. Hermle, A. W. Bett, A. Helbig, and J. H. Werner, *Internal voltages in GaInP/GaInAs/Ge multi-junction solar cells determined by electroluminescence measurements*, *Appl. Phys. Lett.* **92**, 123502 (2008)
6. S. Fahr, C. Ulbrich, T. Kirchartz, U. Rau, C. Rockstuhl, and F. Lederer; *Rugate filter for light-trapping in solar cells*, *Optics Express* **16**, 9332 (2008)

7. C. Ulbrich, S. Fahr, M. Peters, J. Üpping, T. Kirchartz, C. Rockstuhl, J. C. Goldschmidt, P. Löper, R. Wehrspohn, A. Gombert, F. Lederer and U. Rau, *Directional selectivity and light-trapping in solar cells*, Photonics for Solar Energy Systems, Proceedings of SPIE **7002**, 70020A (2008)
8. S. Fahr, C. Ulbrich, T. Kirchartz, U. Rau, C. Rockstuhl, and F. Lederer, *Optimization of Rugate Filters for ultra light-trapping in solar cells*, Photonics for Solar Energy Systems, Proceedings of SPIE **7002**, 70020B (2008)
9. T. Kirchartz, A. Helbig, and U. Rau; *Quantification of light trapping using a reciprocity between electroluminescent emission and photovoltaic Action in a solar cell*, Mater. Res. Soc. Symp. Proc. **1101E**, KK08-03 (2008)
10. C. Ulbrich, T. Kirchartz, and U. Rau, *Enhanced light-trapping in solar cells by directional selective optical filters*, Mater. Res. Soc. Symp. Proc. **1101E**, p. KK08-03 (2008)
11. T. Kirchartz and U. Rau, *Charge separation in excitonic and bipolar solar cells- a detailed balance approach*, Thin Solid Films **516**, 7144 (2008)
12. T. Kirchartz, A. Helbig and U. Rau, *Note on the interpretation of electroluminescence images using their spectral information*, Sol. Energy Mater. Sol. Cells, **92**, 1621 (2008)
13. T. Kirchartz, B. E. Pieters, K. Taretto, and U. Rau, *Electro-optical modeling of bulk heterojunction solar cells*, J. Appl. Phys **104**, 094513 (2008)
14. T. Kirchartz and U. Rau, *Detailed balance and reciprocity in solar cells*, phys. stat. solidi a **205**, 2737 (2008)
15. C. Ulbrich, S. Fahr, J. Üpping, M. Peters, T. Kirchartz, C. Rockstuhl, R. Wehrspohn, A. Gombert, F. Lederer and U. Rau, *Directional selectivity and ultra-light-trapping in solar cells*, phys. stat. solidi a **205**, 2831 (2008)
16. T. Kirchartz, J. Mattheis, and U. Rau, *Detailed balance theory of excitonic and bulk heterojunction solar cells*, Phys. Rev. B **78**, 235320 (2008)

2009

17. T. Kirchartz and U. Rau, *Modeling charge carrier collection in multiple exciton generating PbSe quantum dots*, Thin Solid Films **517**, 2438 (2009)
18. T. Kirchartz, A. Helbig, W. Reetz, M. Reuter, J. H. Werner, and U. Rau, *Reciprocity between electroluminescence and quantum efficiency used for the characterization of silicon solar cells*, Prog. Photovolt: Res. Appl. **17**, 394 (2009)
19. T. Kirchartz, K. Seino, J.-M. Wagner, U. Rau, and F. Bechstedt, *Efficiency limits of Si/SiO₂ quantum well solar cells from first-principles calculations*, J. Appl. Phys., **105**, 104511 (2009)
20. U. Rau, T. Kirchartz, A. Helbig, and B. E. Pieters, *Electroluminescence imaging of Cu(In,Ga)Se₂ thin film solar modules*, Mater. Res. Soc. Symp. Proc. **1165**, M03-04 (2009)
21. M. Peters, J. C. Goldschmidt, T. Kirchartz, and B. Bläsi, *The photonic light trap - improved light trapping in solar cells by angularly selective filters*, Sol. Energy Mater. Sol. Cells, **93**, 1721 (2009)
22. T. Kirchartz, B. E. Pieters, K. Taretto, and U. Rau, *Mobility dependent efficiencies of organic bulk heterojunction solar cells: Surface recombination and charge transfer state distribution*, Phys. Rev. B **80**, 035334 (2009)
23. T. Kirchartz, K. Taretto, and U. Rau, *Efficiency limits of organic bulk heterojunction solar cells*, J. Phys. Chem. C **113**, 17958 (2009)

2010

24. B. E. Pieters, T. Kirchartz, T. Merdzhanova, and R. Carius, *Modeling of photoluminescence spectra and quasi-fermi level splitting in $\mu\text{-Si}$ solar cells*, Sol. Energy Mater. Sol. Cells **94**, 1851 (2010)
25. C. Ulbrich, M. Peters, M. Tayyib, B. Bläsi, T. Kirchartz, A. Gerber, and U. Rau, *Enhanced light trapping in thin amorphous silicon solar cells by directionally selective optical filters*, Proceedings of SPIE **7725**, 77250P (2010)
26. A. Helbig, T. Kirchartz, R. Schäffler, J. H. Werner, and U. Rau, *Quantitative electroluminescence analysis of resistive losses in $\text{Cu}(\text{In}, \text{Ga})\text{Se}_2$ thin-film modules*, Solar Sol. Energy Mater. Sol. Cells **94**, 979 (2010)
27. C. Ulbrich, M. Peters, B. Bläsi, T. Kirchartz, A. Gerber, U. Rau, *Enhanced light trapping in thin-film solar cells by a directionally selective filter*, Optics Express **18**, A133 (2010)
28. M. Schneemann, A. Helbig, T. Kirchartz, R. Carius, and U. Rau, *Reverse biased electroluminescence spectroscopy of crystalline silicon solar cells with high spatial resolution*, physica stat. solidi a **207**, 2597 (2010)

2011

29. T. Kirchartz, B. E. Pieters, J. Kirkpatrick, U. Rau, and J. Nelson, *Recombination via tail states in polythiophene:fullerene solar cells*, Phys. Rev. B **83**, 115209 (2011)
30. S. Schäfer, A. Petersen, T. A. Wagner, R. Kniprath, D. Lingenfeller, A. Zen, T. Kirchartz, B. Zimmermann, U. Würfel, X. J. Feng, T. Mayer, *Influence of the indium tin oxide/organic interface on open-circuit voltage, recombination, and cell degradation in organic small-molecule solar cells*. Phys Rev B **83**, 165311 (2011)
31. R. C. I. Mackenzie, T. Kirchartz, G. F. A. Dibb, and J. Nelson, *Modeling nongeminate recombination in P3HT:PCBM solar cells*. J. Phys. Chem. C **115**, 9806 (2011)
32. G. F. A. Dibb, T. Kirchartz, D. Credgington, J. R. Durrant, and J. Nelson, *Analysis of the relationship between linearity of corrected photocurrent and the order of recombination in organic solar cells*. J. Phys. Chem. Lett. **2**, 2407 (2011)
33. S. Fahr, T. Kirchartz, C. Rockstuhl, and F. Lederer, *Approaching the Lambertian limit in randomly textured thin-film solar cells*, Opt. Express **19**, A865 (2011)
34. K. Ding, T. Kirchartz, B. E. Pieters, C. Ulbrich, A. E. Ermes, S. Schicho, A. Lambertz, R. Carius, and U. Rau, *Characterization and simulation of $a\text{-Si:H}/\mu\text{-Si:H}$ tandem solar cells*, Sol. Energy Mat. Sol. Cells **95**, 3318 (2011)

2012

35. M. Soldera, K. Taretto, and T. Kirchartz, *Comparison of device models for organic solar cells: Band-to-band vs. tail states recombination*, phys. stat. sol. a **209**, 207 (2012)
36. A. Ojala, A. Petersen, A. Fuchs, R. Lovrincic, C. Pölking, J. Trollmann, J. Hwang, C. Lennartz, H. Reichelt, H. W. Höffken, A. Pucci, P. Erk, T. Kirchartz, and F. Würthner, *Merocyanine/C60 planar heterojunction solar cells: effect of dye orientation on exciton dissociation and solar cell performance*, Adv. Funct. Materials. **22**, 86 (2012)
37. M. A. Faist, T. Kirchartz, W. Gong, R. S. Ashraf, I. McCulloch, J. C. de Mello, N. J. Ekins-Daukes, D. D. C. Bradley, and J. Nelson, *Competition between the charge transfer state and the singlet states of donor or acceptor limiting the efficiency in polymer:fullerene solar cells*, J. Am. Chem. Soc. **134**, 685 (2012)
38. A. Petersen, T. Kirchartz, and T. A. Wagner, *Charge extraction and photocurrent in organic bulk heterojunction solar cells*, Phys. Rev. B **85**, 045208 (2012)

39. T. Kirchartz, W. Gong, S. A. Hawks, T. Agostinelli, R. C. I. Mackenzie, Y. Yang, and J. Nelson, *Sensitivity of the Mott-Schottky analysis in organic solar cells*, J. Phys. Chem. C, **116**, 7672 (2012)
40. A. Petersen, A. Ojala, T. Kirchartz, F. Würthner, and U. Rau, *Field dependent exciton dissociation in organic heterojunction solar cells*, Phys. Rev. B **85**, 245208 (2012)
41. F. Lederer, S. Fahr, C. Rockstuhl, and T. Kirchartz, *Approaching the Lambertian Limit in Randomly Textured Thin-Film Solar Cells*, Mater. Res. Soc. Symp. Proc. DOI: <http://dx.doi.org/10.1557/opl.2012.694>
42. W. Gong, M. A. Faist, N. J. Ekins-Daukes, Z. Xu, D. D. C. Bradley, J. Nelson, and T. Kirchartz, *Influence of energetic disorder on electroluminescence emission in polymer:fullerene solar cells*, Phys. Rev. B **86**, 024201 (2012)
43. T. Kirchartz and J. Nelson, *Meaning of reaction orders in polymer:fullerene solar cells*, Phys. Rev. B **86**, 165201 (2012)
44. T. Kirchartz, T. Agostinelli, M. Campoy-Quiles, W. Gong, and J. Nelson, *Understanding the thickness-dependent performance of organic bulk heterojunction solar cells: The influence of mobility, lifetime, and space charge*, J. Phys. Chem. Lett. **3**, 3470 (2012)
45. T. C. M. Müller, B. E. Pieters, T. Kirchartz, and U. Rau, *Modelling of photo- and electroluminescence of hydrogenated microcrystalline solar cells*, phys. stat. sol. C **9**, 1963 (2012)

2013

46. T. M. H. Tran, B. E. Pieters, C. Ulbrich, A. Gerber, T. Kirchartz, and U. Rau, *Transient phenomena in Cu(In,Ga)Se₂ solar modules investigated by electroluminescence imaging*, Thin Solid Films, **535**, 307 (2013)
47. T. Kirchartz, *Influence of diffusion on space charge limited current measurements in organic semiconductors*, Beilstein J. Nanotechnology **4**, 180 (2013)
48. M. A. Faist, S. Shoaee, S. Tuladhar, G. F. A. Dibb, S. Foster, W. Gong, T. Kirchartz, D. D. C. Bradley, J. R. Durrant and J. Nelson, *Understanding the reduced efficiencies of organic solar cells employing fullerene multiadducts as acceptors*, Adv. Energy Mater. **3**, 744 (2013)
49. R. Xia, D.-S. Leem, T. Kirchartz, S. Spencer, C. Murphy, Z. He, H. Wu, S. Su, Y. Cao, J. S. Kim, J. C. deMello, D. D. C. Bradley and J. Nelson, *Detailed investigation of a conjugated polyelectrolyte interlayer for high performance inverted polymer solar cells*, Adv. Energy Mater. **3**, 718 (2013)
50. S. A. Hawks, F. Deledalle, J. Yao, D. G. Rebois, G. Li, J. Nelson, Y. Yang, T. Kirchartz, and J. R. Durrant, *Relating recombination, density of states, and device performance in an efficient polymer:fullerene organic solar cell blend*, Adv. Energy Mater. **3**, 1201 (2013)
51. N. Bansal, L. X. Reynolds, A. MacLachlan, T. Lutz, R. S. Ashraf, W. Zhang, C. B. Nielsen, I. McCulloch, D. G. Rebois, T. Kirchartz, M. S. Hill, K. C. Molloy, J. Nelson, and S. A. Haque, *Influence of crystallinity and energetics on charge separation in polymer-inorganic nanocomposite films for solar cells*, Scientific Reports **3**, 1531 (2013)
52. T. C. M. Müller, B. E. Pieters, U. Rau, and T. Kirchartz, *Analysis of the series resistance in pin-type thin-film silicon solar cells*, J. Appl. Phys. **113**, 134503 (2013)
53. T. Kirchartz, F. Deledalle, P. S. Tuladhar, J. R. Durrant, and J. Nelson, *On the differences between Dark and Light Ideality Factor in Polymer:Fullerene Solar Cells*, J. Phys. Chem. Lett. **4**, 2371 (2013)
54. T. Kirchartz and J. Nelson, *Device modeling of organic bulk-heterojunction solar cells*, Topics in Current Chemistry – Special Issue: Computational Photovoltaics (edited by D. Beljonne and J. Cornil)

55. T. M. H. Tran, B. E. Pieters, M. Schneemann, T.C.M. Müller, A. Gerber, T. Kirchartz, and U. Rau, *Local junction voltages and radiative ideality factors of a-Si:H solar modules determined by electroluminescence imaging technique*, Mater. Res. Soc. Symp. Proc. **1536** (2013)
56. I. Meager, R. S. Ashraf, S. Mollinger, B. C. Schroeder, H. Bronstein, D. Beatrup, M. S. Vezie, T. Kirchartz, A. Salleo, J. Nelson, and I. McCulloch, *Photocurrent Enhancement from Diketopyrrolopyrrole Polymer Solar Cells through Alkyl-Chain Branching Point Manipulation*, J. Am. Chem. Soc. **135**, 11537 (2013)
57. M. Schneemann, T. Kirchartz, R. Carius, and U. Rau, *Measurement and modeling of reverse biased electroluminescence in multi-crystalline silicon solar cells*, J. Appl. Phys. **114**, 134509 (2013)
58. H. Bronstein, M. Hurhangee, E. Collado Fregoso, D. Beatrup, Y. W. Soon, Z. Huang, A. Hadipour, P. S. Tuladhar, S. Rossbauer, E.-H. Soon, S. Shoaee, S. D. Dimitrov, J. M. Frost, R. S. Ashraf, T. Kirchartz, S. E. Watkins, K. Song, T. Anthopoulos, J. Nelson, B. P. Rand, J. R. Durrant, and I. McCulloch, *Isostructural, Deeper Highest Occupied Molecular Orbital Analogues of Poly(3-hexylthiophene) for High-Open Circuit Voltage Organic Solar Cells*, Chem. Mater. **25**, 4239 (2013)
59. T. M. H. Tran, B. E. Pieters, M. Schneemann, T.C.M. Müller, A. Gerber, T. Kirchartz, and U. Rau, *Quantitative evaluation method for electroluminescence images of a-Si:H thin film solar modules*, phys. stat. sol.- RRL **7**, 627 (2013)
60. J. W. Ryan, T. Kirchartz, A. Viterisi, J. Nelson and E. Palomares, *Understanding the Effect of Donor Layer Thickness and a MoO₃ Hole Transport Layer on the Open-Circuit Voltage in Squaraine/C₆₀ Bilayer Solar Cells*, J. Phys. Chem. C **117**, 19866 (2013)
61. G. F. A. Dibb, M.-A. Muth, T. Kirchartz, S. Engmann, H. Hoppe, G. Gobsch, M. Thelakatt, N. Blouin, S. Tierney, M. Carrasco-Orozco, J. R. Durrant, and J. Nelson, *Influence of doping on charge carrier collection in normal and inverted geometry polymer:fullerene solar cells*, Sci. Rep. **3**, 3335 (2013)