# Publikationsverzeichnis – PD Dr. Andreas Opitz

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## Akademische Arbeiten

*Juli 2009* ***Habilitation (Lehrbefähigung)***

Universität Augsburg – Institut für Physik
Titel der Habilitationsschrift: *Charge carrier generation and transport at interfaces in organic semiconductor devices*

*Februar 2003* ***Promotion (Dr. rer. nat.)***

Technische Universität Ilmenau – Institut für Physik
Titel der Dissertation: *Nanotribologische Untersuchungen von ultradünnen Wasserfilmen auf hydrophoben und hydrophilen Siliziumoberflächen*

*Oktober 1997* ***Diplom im Studienfach Physik (Dipl.-Phys.)***

Martin-Luther-Universität Halle/Wittenberg – Fachbereich für Physik
Titel der Diplomarbeit: *Rastertunnelmikroskopie an reiner und an Pt-bedeckter Si(111)7x7-Oberfläche*

## Buchkapitel

Charge Separation at Nanostructured Molecular Donor–Acceptor Interfaces
**A. Opitz**, R. Banerjee, S. Grob, M. Gruber, A. Hinderhofer, U. Hörmann, J. Kraus, T. Linderl, C. Lorch, A. Steindamm, A.K. Topczak, A. Wilke, N. Koch, J. Pflaum, F. Schreiber, W. Brütting
in K. Leo (Ed.) Elementary Processes in Organic Photovoltaics
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Ambipolar charge-carrier transport in molecular field-effect transistors
**A. Opitz**, W. Brütting
in W. Brütting; C. Adachi (Eds.) Physics of Organic Semiconductors ($2^{nd}$ edition)
Wiley-VCH (2012) 239–265.
doi: 10.1002/9783527654949.ch8

Ambipolar charge carrier transport in organic semiconductor blends
M. Bronner, **A. Opitz**, W. Brütting
in C. Wöll (Ed.) Physical and Chemical Aspects of Organic Electronics,
Wiley-VCH (2009) 347–372.
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Surface Science tools and their application to nanosystems like $C_{60}$ on indium phosphide
J.A. Schaefer, G. Cherkashinin, S. Döring, M. Eremtchenko, S. Krischok, D. Malsch, **A. Opitz**, T. Stolz, R. Temirov
in E.V. Buzaneva, P. Scharff (Eds.) Frontiers of Multifunctional Integrated Nanosystems,
Kluwer Academic Publishers (2003) 131–138.
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## Zeitschriftenartikel

2024

Two isomeric thienoacenes in thin films: Unveiling the influence of molecular structure and intermolecular packing on electronic properties
C. Gatsios, M. Dreher, P. Amsalem, **A. Opitz**, R. Jouclas, Y. Geerts, G. Witte, N. Koch
*J. Phys. Chem. C* **128** (20024) 21228–21236.
doi: 10.1021/acs.jpcc.4c06741

Terrylene on monolayer $WS_2$: coverage-dependent molecular re-orientation and interfacial electronic energy levels
Q. Wang, S. You, B. Kobin, P. Amsalem, F. Zu, R. Wang, **A. Opitz**, S. Hecht, L. Chi, N. Koch
*Mater. Adv.* **5** (2024) 9604–9612.
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The Role of the Solvent on the Orientation of Y-type Acceptor Molecules in Spin-coated Films
L.P. Christopholi, C.F.N. Marchiori, I. Jalan, **A. Opitz**, S.A. Muntean, E. Moons
*J. Phys. Chem. C* **128** (2024) 17825–17835.
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Laser-induced tuning of crystallization in tetracene thin films
A. Asyuda, J. Müller, M.F. Gholami, A. Zykov, L. Pithan, C.T. Koch, J.P. Rabe, **A. Opitz**, S. Kowarik
*Phys. Chem. Chem. Phys.* **26** (2024) 24841–24848.
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Non-equilibrium transport in polymer mixed ionic-electronic conductors at ultra-high charge densities
D.H.L. Tjhe, X. Ren, I.E. Jacobs, G. D'Avino, T.B.E. Mustafa, T.G. Marsh, L. Zhang, Y. Fu, A.E. Mansour, **A. Opitz**, Y. Huang, W. Zhu, A. Hamdi Unal, S. Hoek, V. Lemaur, C. Quarti, Q. He, J.-K. Lee, I. McCulloch, M. Heeney, N. Koch, C.P. Grey, D. Beljonne, S. Fratini, H. Sirringhaus
*Nature Mater.* **23** (2024) 1712–1719.
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2023

Surface doping of rubrene single crystals by molecular electron donors and acceptor
C. Gatsios, **A. Opitz**, D. Lungwitz, A.E. Mansour, T. Schultz, D. Shin, S. Hammer, J. Pflaum, Y. Zhang, S. Barlow, S.R. Marder, N. Koch
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Coordination of tetracyanoquinodimethane-derivatives with tris(pentafluorophenyl)borane provides stronger p-dopants with enhanced stability
A.E. Mansour, R. Warren, D. Lungwitz, M. Forster, U. Scherf, **A. Opitz**, M. Malischewski, N. Koch
*ACS Appl. Mater. Interfaces* **15** (2023) 46148–46156.
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Spectral Signatures of a Negative Polaron in a Doped Polymer Semiconductor: Energy Levels and Hubbard *U* Interactions
D. Lungwitz, S. Joy, A.E. Mansour, **A. Opitz**, C. Karunasena, H. Li, N.A. Panjwani, K. Moudgil, K. Tang, J. Behrends, S. Barlow, S.R. Marder, J.-L. Brédas, K. Graham, N. Koch, A. Kahn
*J. Phys. Chem. Lett.* **14** (2023) 5633–5640.
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Improving the resistance of molecularly doped polymer semiconductor layers to solvent
D. Lungwitz, A.E. Mansour, Y. Zhang, **A. Opitz**, S. Barlow, S.R. Marder, N. Koch
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2022 Photooxidation of PC60BM: New Insights from Spectroscopy
I.E. Brumboiu, L.K.E. Ericsson, V. Blazinic, R. Hansson, **A. Opitz**, B. Brena, E. Moons
*Phys. Chem. Chem. Phys.* **24** (2022) 25753–25766.
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Use of a Multiple Hydride Donor to Achieve an n-Doped Polymer with High Solvent Resistance
F. Saeedifard, D. Lungwitz, Z.-D. Yu, S. Schneider, A.E. Mansour, **A. Opitz**, S. Barlow, M.F. Toney, J. Pei, N. Koch, S.R. Marder
*ACS Appl. Mater. Interfaces* **14** (2022) 33598–33605.
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Quantum Efficiency Enhancement of Lead-Halide Perovskite Nanocrystal LEDs by Organic Lithium Salt Treatment
T. Naujoks, R. Jayabalan, C. Kirsch, F. Zu, M. Mandal, J. Wahl, M. Waibel, **A. Opitz**, N. Koch, D. Andrienko, M. Scheele, W. Brütting
*ACS Appl. Mater. Interfaces* **14** (2022) 28985–28996.
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Understanding the evolution of the Raman spectra of molecularly p-doped poly(3-hexylthiophene-2,5-diyl): signatures of polarons and bipolarons
A. Mansour, A. Valencia, D. Lungwitz, B. Wegner, N. Tanaka, Y. Shoji, T. Fukushima. **A. Opitz**, C. Cocchi, N. Koch
*Phys. Chem. Chem. Phys.* **24** (2022) 3109–3118.
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Thin films of electron donor-acceptor complexes: characterisation of mixed-crystalline phases and implications for electrical doping
**A. Opitz**, G. Duva, M. Gebhardt, H. Kim, E. Meister, T. Meisel, P. Beyer, V. Belova, C. Kasper, J. Pflaum, L. Pithan, A. Hinderhofer, F. Schreiber, W. Brütting
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2021 Kinetic Study on the Adsorption of 2,3,5,6-Tetrafluoro-7,7,8,8-tetracyanoquinodimethane on Ag Nanoparticles in Chloroform: Implications for the Charge Transfer Complex of Ag-$F_4$TCNQ
Y. Zhao, **A. Opitz**, A. Eljarrat, Z. Kochovski, C. Koch, N. Koch, Y. Lu
*ACS Appl. Nano Mater.* **4** (2021) 11625–11635.
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Coupled Organic–Inorganic Nanostructures with Mixed Organic Linker Molecules
F. Grassl, A. Ullrich, A.E. Mansour, S.M. Abdalbaqi, N. Koch, **A. Opitz**, M. Scheele, W. Brütting
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Disentangling bulk and interface phenomena in a molecularly doped polymer semiconductor
D. Lungwitz, T. Schultz, C.E. Tait, J. Behrends, S.K. Mohapatra, S. Barlow, S.R. Marder, **A. Opitz**, N. Koch
*Adv. Optical Mater.* **9** (2021) 2002039.
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2020

Conductive polymer work function changes due to residual water: Impact of temperature dependent dielectric constant
A.E. Mansour, H. Kim, S. Park, T. Schultz, D.X. Cao, T.-Q. Nguyen, W. Brütting, **A. Opitz**, N. Koch
*Adv. Electron. Mater.* **6** (2020) 2000408.
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Fermi level pinned molecular donor/acceptor junctions: reduction of induced carrier density by interfacial charge transfer complexes
P. Beyer, E. Meister, T. Florian, A. Generalov, W. Brütting, N. Koch, **A. Opitz**
*J. Mater. Chem. C* **8** (2020) 15199–15207.
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Single-step formation of low work function cathode interlayer and n-type bulk doping from semiconducting polymer/polyethylenimine blend solution
K. Seidel,* D. Lungwitz,* **A. Opitz**,* T. Krüger, J. Behrends, S.R. Marder, N. Koch
*ACS Appl. Mater. Interfaces* **12** (2020) 28801–28807.
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An organic borate salt with superior p-doping capability for organic semiconductors
B. Wegner, D. Lungwitz, A.E. Mansour, C.E. Tait, N. Tanaka, T. Zhai, S. Duhm, M. Forster, J. Behrends, Y. Shoji, **A. Opitz**, U. Scherf, E.J.W. List-Kratochvil, T. Fukushima, N. Koch
*Adv. Sci.* **7** (2020) 2001322.
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Ordered donor-acceptor complex formation and electron transfer in co-deposited films of structurally dissimilar molecules
**A. Opitz**, C. Peter, B. Wegner, H.S.S.R. Matte, A. Röttger, T. Florian, X. Xu, P. Beyer, L. Grubert, S. Hecht, V. Belova, A. Hinderhofer, F. Schreiber, C. Kasper, J. Pflaum, Y. Zhang, S. Barlow, S.R. Marder, N. Koch
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Electrode work function reduction by polyethylenimine interlayers: Choice of solvent and residual solvent removal for superior functionality
S. Bontapalle,* **A. Opitz**,* R. Schlesinger, S.R. Marder, S. Varughese, N. Koch
*Adv. Mater. Interface* **7** (2020) 2000291.
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Utilizing Diels-Alder “Click” chemistry to functionalize the organic-organic interface of semiconducting polymers
D. Burmeister, L. Ahrens, **A. Opitz**, G. Ligorio, F. Hermerschmidt, D. Jänsch, J. Freudenberg, U.H.F. Bunz, K. Müllen, E.J.W. List-Kratochvil
*J. Mater. Chem. C* **8** (2020) 3302–3307.
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The optical signatures of molecular-doping induced polarons in poly(3-hexylthiophene-2,5-diyl): individual polymer chains versus aggregates
A. E. Mansour, D. Lungwitz, T. Schultz, M. Arvind, A.M. Valencia, C. Cocchi, **A. Opitz**, D. Neher, N. Koch
*J. Mater. Chem. C* **8** (2020) 2870–2879.
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* These authors contributed equally to this work.

2019 Predicting the yield of ion pair formation in molecular electrical doping: redox-potentials versus ionization energy / electron affinity
B. Wegner, L. Grubert, C. Dennis, **A. Opitz**, A. Röttger, Y. Zhang, S. Barlow, S.R. Marder, S. Hecht, K. Müllen N. Koch
*J. Mater. Chem. C* **7** (2019) 13839–13848.
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Impact of intentional photo-oxidation of donor polymer and $PC_{70}BM$ acceptor on solar cell performance
V. Blazinic, L.K.E. Ericsson, I. Levine, R. Hansson, **A. Opitz**, E. Moons
*Phys. Chem. Chem. Phys.* **21** (2019) 22259–22271.
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Ground-state charge-transfer interactions in donor:acceptor pairs of organic semiconductors. A spectroscopic study of two representative systems
G. Duva, P. Beyer, R. Scholz, V. Belova, **A. Opitz**, A. Hinderhofer, A. Gerlach, F. Schreiber
*Phys. Chem. Chem. Phys.* **21** (2019) 17190–17199.
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S. Park, T. Schultz, A. Han, A. Aljarb, X. Xu, P. Beyer, **A. Opitz**, R. Ovsyannikov, L.-J. Li, M. Meissner, T. Yamaguchi, S. Kera, P. Amsalem, N. Koch
*Comm. Phys.* **2** (2019) 68.
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State-of-matter dependent charge transfer interactions between planar molecules for doping applications
P. Beyer, D. Pham, C. Peter, N. Koch, E. Meister, W. Brütting, L. Grubert, S. Hecht, D. Nabok, C. Cocchi, C. Draxl, **A. Opitz**
*Chem. Mater.* **31** (2019) 1237–1249.
doi: 10.1021/acs.chemmater.8b01447

2018 Unraveling the microstructure of molecularly doped P3HT by thermally-induced de-doping
H. Hase, K. O'Neill, J. Frisch, **A. Opitz**, N. Koch, I. Salzmann
*J. Phys. Chem. C* **122** (2018) 25893–25899.
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Thin Film Texture and Optical Properties of Donor:Acceptor Complexes. Diindenoperylene:F6TCNNQ vs Alpha-Sexithiophene:F6TCNNQ
G. Duva, L. Pithan, C. Zeiser, B. Reisz, J. Dieterle, B. Hofferberth, P. Beyer, L. Bogula, **A. Opitz**, S. Kowarik, A. Hinderhofer, A. Gerlach, F. Schreiber
*J. Phys. Chem. C* **122** (2018) 18705–18713.
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Microstructure and Elastic Constants of Transition Metal Dichalcogenide Monolayers from Friction and Shear Force Microscopy
X. Xu, T. Schultz, Z. Qin, N. Severin, B. Haas, S. Shen, J.N. Kirchhof, **A. Opitz**, C.T. Koch, K. Bolotin, J.P. Rabe, G. Eda, N. Koch
*Adv. Mater.* **30** (2018) 1803748.
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2017 Design principles of carbazole/dibenzothiophene derivatives as host material in modern efficient organic light-emitting diodes
J. Li, S.-C. Dong, **A. Opitz**, L.-S. Liao, N. Koch
*J. Mater. Chem. C* **5** (2017) 6989–6996.
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Evidence for Anisotropic Electronic Coupling of Charge Transfer States in Weakly Interacting Organic Semiconductor Mixtures
V. Belova, P. Beyer, E. Meister, T. Linderl, M.-U. Halbich, M. Gerhard, S. Schmidt, T. Zechel, T. Meisel, A.V. Generalov, A.S. Anselmo, R. Scholz, O. Konovalov, A. Gerlach, M. Koch, A. Hinderhofer, **A. Opitz**, W. Brütting, F. Schreiber
*J. Am. Chem. Soc.* **139** (2017) 8474–8486.
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Energy level alignment at planar organic heterojunctions: influence of contact doping and molecular orientation
**A. Opitz**
*J. Phys.: Condens. Matter* **29** (2017) 133001. [Topical review]
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Low temperature processed NiOx hole transport layers for efficient polymer solar cells
S.D. Chavhan, R. Hansson, L.K.E. Ericsson, P. Beyer, A. Hofmann, W. Brütting, **A. Opitz**, E. Moons
*Org. Electron.* **44** (2017) 59-66.
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Direct Photoalignment and Optical Patterning of Molecular Thin Films
L. Pithan, P. Beyer, L. Bogula, A. Zykov, P. Schäfer, J. Rawle, C. Nicklin, **A. Opitz**, S. Kowarik
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Brodie vs Hummers graphite oxides for preparation of multi-layered materials
A.V. Talyzin, G. Mercier, A. Klechikov, M. Hedenström, D. Johnels, D. Wei, D. Cotton, **A. Opitz**, E. Moons
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2016 Photo-degradation in air of the active layer components in a thiophene-quinoxaline copolymer:fullerene solar cell
R. Hansson, C. Lindqvist, L.K.E. Ericsson, **A. Opitz**, E. Wang, E. Moons
*Phys. Chem. Chem. Phys.* **18** (2016) 11132–11138.
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Organic heterojunctions: Contact-induced molecular reorientation, interface states, and charge re-distribution
**A. Opitz**, A. Wilke, P. Amsalem, M. Oehzelt, R.-P. Blum, J.P. Rabe, T. Mizokuro, U. Hörmann, R. Hansson, E. Moons, N. Koch
*Sci. Rep.* **6** (2016) 21291.
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Effective work function reduction of practical electrodes using an organometallic dimer
K. Akaike, M.V. Nardi, M. Oehzelt, J. Frisch, **A. Opitz**, C. Christodoulou, G. Ligorio, P. Beyer, M. Timpel, I. Pis, F. Bondino, K. Moudgil, S. Barlow, S.R. Marder, N. Koch
*Adv. Funct. Mater.* **26** (2016) 2493–2502.
doi: 10.1002/adfm.201504680

2015 Thermally driven smoothening of molecular thin films: Structural transitions in n-alkane layers studied in real-time
L. Pithan, E. Meister, C. Jin, C. Weber, A. Zykov, K. Sauer, W. Brütting, H. Riegler, **A. Opitz**, S. Kowarik
*J. Chem. Phys.* **143** (2015) 164707.
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Charge-transfer crystallites as molecular electrical dopants
H. Méndez, G. Heimel, S. Winkler, J. Frisch, **A. Opitz**, K. Sauer, B. Wegner, M. Oehzelt, C. Röthel, S. Duhm, D. Többens, N. Koch, I. Salzmann
*Nature Comm.* **6** (2015) 8560.
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Solvent vapor annealing on perylene-based organic solar cells
S. Grob, A.N. Bartynski, **A. Opitz**, M. Gruber, F. Grassl, E. Meister, T. Linderl, U. Hörmann, C. Lorch, E. Moons, F. Schreiber, M.E. Thompson, W. Brütting
*J. Mater. Chem. A* **3** (2015) 15700–15709.
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Effect of molecular electrical doping on polyfuran based photovoltaic cells
S. Yu , J. Frisch , **A. Opitz** , E. Cohen , M. Bendikov , N. Koch , I. Salzmann
*Appl. Phys. Lett.* **106** (2015) 203301.
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Vertical and lateral morphology effects on solar cell performance for a thiophene-quinoxaline copolymer:$PC_{70}BM$ blend
R. Hansson, L.K.E. Ericsson, N.P. Holmes, J. Rysz, **A. Opitz**, M. Campoy-Quiles, E. Wang, M.G. Barr, A.L.D. Kilcoyne, X. Zhou, P. Dastoor, E. Moons
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Charge transfer in and conductivity of molecularly doped thiophene-based copolymers
F. Ghani, **A. Opitz**, P. Pingel, G. Heimel, I. Salzmann, J. Frisch, D. Neher, A. Tsami, U. Scherf, N. Koch
*J. Polym. Sci. B Polym. Phys.* **53** (2015) 58–63.
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2014 $V_{oc}$ from a Morphology Point of View: the Influence of Molecular Orientation on the Open Circuit Voltage of Organic Planar Heterojunction Solar Cells
U. Hörmann, C. Lorch, A. Hinderhofer, A. Gerlach, M. Gruber, J. Kraus, B. Sykora, S. Grob, T. Linderl, A. Wilke, **A. Opitz**, R. Hansson, A.-S. Anselmo, Y. Ozawa, Y. Nakayama, H. Ishii, N. Koch, E. Moons, F. Schreiber, W. Brütting
*J. Phys. Chem. C* **118** (2014) 26462–26470.
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Performance enhancement of diindenoperylene-based organic photovoltaic cells by nanocolumn-arrays
S. Yu, **A. Opitz**, S. Grob, R. Resel, M. Oehzelt, W. Brütting, I. Salzmann, N. Koch
*Org. Electron.* **15** (2014) 2210–2217.
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2013 Doping of Organic Semiconductors: Impact of Dopant Strength and Electronic Coupling
H. Méndez, G. Heimel, **A. Opitz**, K. Sauer, P. Barkowski, M. Oehzelt, J. Soeda, T. Okamoto, J. Takeya, J.-B. Arlin, J.-Y. Balandier, Y. Geerts, N. Koch, I. Salzmann
*Angew. Chem. Int. Ed.* **52** (2013) 7751–7755.
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M. Gruber, M. Rawolle, J. Wagner, D. Magerl, U. Hörmann, J. Perlich, S. V. Roth, **A. Opitz**, F. Schreiber, P. Müller-Buschbaum, W. Brütting
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Energy level alignment at interfaces in organic photovoltaic devices
**A. Opitz**, J. Frisch, R. Schlesinger, A. Wilke, N. Koch
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2012 Correlation between interface energetics and open circuit voltage in organic photovoltaic cells
A. Wilke, J. Endres, U. Hörmann, J. Niederhausen, R. Schlesinger, J. Frisch, P. Amsalem, J. Wagner, M. Gruber, **A. Opitz**, A. Vollmer, W. Brütting, A. Kahn, N. Koch
*Appl. Phys. Lett.* **101** (2012) 233301.
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Bipolar charge transport in organic field-effect transistors: Enabling high mobilities and transport of photo-generated charge carriers by a molecular passivation layer
**A. Opitz**, M. Horlet, M. Kiwull, J. Wagner, M. Kraus, W. Brütting
*Org. Electron.* **13** (2012) 1614–1622.
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Thermodynamic efficiency limit of molecular donor-acceptor solar cells and its application to diindenoperylene/$C_{60}$ based planar hetero-junction devices
M. Gruber, J. Wagner, K. Klein, U. Hörmann, **A. Opitz**, M. Stutzmann, W. Brütting
*Adv. Energy Mater.* **9** (2012) 1100–1108.
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Identification of different origins for s-shaped current voltage characteristics in planar heterojunction organic solar cells
J. Wagner, M. Gruber, A. Wilke, Y. Tanaka, K. Topczak, A. Steindamm, U. Hörmann, **A. Opitz**, Y. Nakayama, H. Ishii, J. Pflaum, N. Koch, W. Brütting
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2011 Approaching the ultimate open circuit voltage in thiophene based single junction solar cells by applying diindenoperylene as acceptor
U. Hörmann, J. Wagner, M. Gruber, **A. Opitz**, W. Brütting
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M. Horlet, M. Kraus, W. Brütting, **A. Opitz**
*Appl. Phys. Lett.* **98** (2011) 233304.
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M. Kraus, S. Haug, W. Brütting, **A. Opitz**
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J. Wagner, M. Gruber, A. Hinderhofer, A. Wilke, B. Bröker, J. Frisch, P. Amsalem, A. Vollmer, **A. Opitz**, N. Koch, F. Schreiber, W. Brütting
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