

Literaturverzeichnis

- [Abi87] B. Abid, J. Gong, H. Goslawsky und K. Bachmann. *CuInS_{2-y}Se_{2-2y} and CuInGa_xIn_{1-x}Se₂: bulk crystal growth conditions and properties.* In *Proc. of 19th IEEE*. S. 1305, New York, 1987
- [Aki92] K. Akimoto, H. Okuyama, M. Ikeda und Y. Mori. *Isoelectric oxygen in II-VI semiconductors.* Appl. Phys. Lett., 60 (1992), S. 91
- [Aud51] L. F. Audrieth und B. A. Ogg. *The chemistry of hydrazine.* John Wiley, New York, 1951
- [Bay02] R. Bayon, M. Hernandez-Mayoral und J. Herrero. *Growth mechanism of CBD-In(OH)_xS_y thin films.* J. Electrochem. Soc., 149 (2002), S. 1
- [Bee72] B. Beeston, R. Horne und R. Markham. *Electron diffraction and optical diffraction techniques.* North Holland/American Elsevier, Amsterdam, London, New York, 1972
- [Ber87] L. Bergmann. *Lehrbuch der Experimentalphysik, Optik, Band 3.* Walter de Gruyter, New York, Berlin, 1987
- [Bie80] J. Biersack und L. Haggmark. Nucl. Instr. and Methods, 174 (1980), S. 257
- [Boh] W. Bohne. *Mitteilung*
- [Boh98a] W. Bohne, J. Röhrich und G. Röschert. *The Berlin time-of-flight ERDA setup.* Nucl. Inst. and Methods B, 136-138 (1998), S. 633
- [Boh98b] W. Bohne, J. Röhrich und G. Röschert. *The new time-of-flight ERDA setup at the HMI-Berlin.* Nucl. Inst. and Methods B, 139 (1998), S. 219
- [Bör82] L. Börnstein. *Zahlenwerte und Funktionen aus Naturwissenschaft und Technik.* Springer-Verlag, 1982
- [Bri78] D. Briggs. *Handbook of X-ray and ultraviolet photoelectron spectroscopy.* Heyden, London, 1978
- [Bri83] D. Briggs und M. P. Seah. *Practical surface analysis by Auger and X-ray photoelectron spectroscopy.* John Wiley, New York, 1983
- [Bur96] A. Burgers, J. Eikelboom, A. Schönecker und W. Sinke. *Improved treatment of the strongly varying slope in fitting solar cell I-V curves.* In *Proc. of 25th IEEE*. S. 569, Anaheim (CA), 1996
- [Bur00] M. Burgelman, P. Nollet und S. Degraeve. *Modeling polycrystalline semiconductor solar cells.* Thin Solid Films, 361 (2000), S. 527
- [Cah89] D. Cahen und R. Noufi. *Defect chemical explanation for the effect of air anneal on CdS/CuInSe₂ solar cell performance.* Appl. Phys. Lett., 54 (1989), S. 558

- [Cam90] D. Cammack, K. Shahzad und T. Marshall. *Low-temperature growth by molecular beam epitaxy using cracked selenium.* Appl. Phys. Lett., 56 (1990), S. 845
- [Can00] B. Canava, J.-F. Guillemoles, E.-B. Yousfi, P. Cowache, H. Kerber, A. Loeffl, H.-W. Schock, M. Powalla, D. Hariskos und D. Lincot. *Wet treatment based interface engineering for high efficiency Cu(In,Ga)Se₂ solar cells.* Thin Solid Films, 361-362 (2000), S. 187
- [Cha00a] A. Chaparro, R. Bayon, M. Gutierrez, J. Herrero, J. Klaer, K. Siemer und D. Bräunig. *Comparative study of high efficiency thin film solar cells based on CuInS₂ absorber and alternative buffer layers.* In *Proc. of 16th E-PVSEC.* Glasgow, UK, 2000
- [Cha00b] A. Chaparro, C. Maffiotte, M. Gutierrez und J. Herrero. *Morphological and compositional study of CBD-ZnSe thin films by microscopy techniques and angle resolved XPS.* Thin Solid Films, 358 (2000), S. 22
- [Cha00c] A. Chaparro, M. Martinez, C. Guillen, R. Bayon, M. Gutierrez und J. Herrero. *SnO₂ substrate effects on the morphology and composition of chemical bath deposited ZnSe thin films.* Thin Solid Films, 361-362 (2000), S. 177
- [Cha01a] A. Chaparro, M. Gutierrez, J. Herrero und J. Klaer. *Influence of chemical bath deposition parameters on the formation of CuInS₂/Zn(Se,O) junctions for thin film solar cells.* In *Proc. of MRS spring meeting.* H2.9.1, San Francisco, 2001
- [Cha01b] A. Chaparro, C. Maffiotte, M. Gutierrez, J. Herrero, J. Klaer, K. Siemer und D. Bräunig. *Characterization of CuInS₂/ZnSe junctions by XPS and electroreflectance.* Thin Solid Films, 387 (2001), S. 104
- [Che95a] J. Chen, Y. Zhang, B. Skromme, K. Akimoto und S. Pachuta. *Properties of the shallow O-related acceptor level in ZnSe.* J. Appl. Phys., 78 (1995), S. 5109
- [Che95b] L. Chernyak, K. Gartsman, D. Cahen und O. Stafsudd. *Electronic effects of ion mobility in semiconductors: semionic behaviour of CuInSe₂.* J. Phys. Chem. Solids, 56 (1995), S. 1165
- [Con99] M. A. Contreras, B. Egaas, K. Ramanathan, J. Hiltner, A. Swartzlander, F. Hasoon und R. Noufi. *Progress towards 20% efficiency in Cu(In,Ga)Se₂ polycrystalline thin-film solar cells.* Progress in Photovoltaics, 7 (1999), S. 311
- [Dam83] H. Damjantschitsch, M. Weiser, G. Heussner, S. Kalbitzer und H. Mannsperger. *An in-beam low-level system for nuclear reaction γ -rays.* Nucl. Instr. and Methods, 218 (1983), S. 129
- [deM88] J. deMiguel, S. Shibli, M. Tamargo und B. Skromme. *Planar doping with gallium of molecular beam epitaxial ZnSe.* Appl. Phys. Lett., 53 (1988), S. 2065
- [Der92] G. Deroubaix und P. Marcus. *X-ray photoelectron spectroscopy analysis of Copper and Zinc oxides and sulphides.* Surf. and Interf. Anal., 18 (1992), S. 39
- [Don94] J. M. Dona und J. Herrero. *Process and film characterization of chemical-bath-deposited ZnS thin films.* J. Electrochem. Soc., 141 (1994), S. 205
- [Don95] J. M. Dona und J. Herrero. *Chemical-bath deposition of ZnSe thin films.* J. Electrochem. Soc., 142 (1995), S. 764
- [Dyl00] T. Dylla. *Charakterisierung von CuGaSe₂-Dünnschicht-Solarzellen hergestellt mit chemischer Gasphasenabscheidung.* Diplomarbeit, Freie Universität Berlin (2000)

- [Eis98] I. Eisgruber, J. Granata, J. Sites, J. Hou und J. Kessler. *Blue photon modification of nonstandard diode barrier in CuInSe₂ solar cells.* Solar Energy Materials and Solar Cells, 53 (1998), S. 367
- [Eng98] F. Engelhardt, M. Schmidt, T. Meyer, O. Seifert, J. Parisi und U. Rau. *Metastable electrical transport in Cu(In,Ga)Se₂ thin films and ZnO/CdS/Cu(In,Ga)Se₂ heterostructures.* Phys. Lett. A, 245 (1998), S. 489
- [Eng99] F. Engelhardt, L. Bornemann, M. Köntges, T. Meyer, J. Parisi, E. Pschorr-Schoberer, B. Hahn, W. Gebhardt, W. Riedl und U. Rau. *Cu(In,Ga)Se₂ solar cells with a ZnSe buffer layer: Interface characterization by quantum efficiency measurements.* Progress in Photovoltaics, 7 (1999), S. 423
- [Enn00] A. Ennaoui, M. Weber, M. Saad, W. Harneit, M. Lux-Steiner und F. Karg. *Chemical bath deposited Zn(Se,OH)_x on Cu(In,Ga)(S,Se)₂ for high efficiency solar cells: growth kinetics, electronic properties, device performance and loss analysis.* Thin Solid Films, 361-362 (2000), S. 450
- [Enn01] A. Ennaoui, S. Siebentritt, M. Lux-Steiner, W. Riedl und F. Karg. *High-efficiency Cd-free CIGSS thin-film solar cells with solution grown zinc compound buffer layers.* Solar Energy Materials and Solar Cells, 67 (2001), S. 31
- [Ero85] M. Eron und A. Rothwarf. *Interface charging and solar-cell characteristics: CuInSe₂/CdS.* J. Appl. Phys., 57 (1985), S. 2275
- [Fah83] A. L. Fahrenbruch und R. H. Bube. *Fundamentals of solar cells.* Academic Press, Inc., New York, 1983
- [Fei50] W. Feitknecht und E. Häberli. *Über die Löslichkeitsprodukte einiger Hydroxidverbindungen des Zinks.* Hel. Chim. Acta, XXXIII, Fasciculus IV (1950), S. 923
- [Fis] C.-H. Fischer. *Mitteilung*
- [Fle95] S. Flegler, J. Heckman und K. Klomparens. *Elektronenmikroskopie.* Spektrum Akademischer Verlag, Heidelberg, Berlin, Oxford, 1995
- [FM02] D. Fuertes-Marron, A. Meeder, U. Bloeck, P. Schubert-Bischoff, N. Pfänder, R. Würz, S. Babu, T. Schedel-Niedrig und M. Lux-Steiner. *Microstructural properties of CVD-grown CuGaSe₂ based thin film solar cells.* Thin Solid Films, to be published (2002)
- [Fro95] M. Fromment und D. Lincot. *Phase formation process in solution at the atomic level: Metal chalcogenide semiconductors.* Electrochim. acta, 40 (1995), S. 1293
- [Fuh00] W. Fuhs. *Photovoltaik - Stand und Perspektiven.* Forschungsverbund Sonnenenergie (FVS), Themen 2000, (2000), S. 14
- [Ger00] A. Gerhard. *Elektrische Defektspektroskopie an CuGaSe₂ und verwandten Halbleiterdünnsschichten.* Dissertation, Freie Universität Berlin (2000)
- [Gie] M. Giersig. *Mitteilung*
- [Gol92] J. Goldstein, D. Newbury, P. Echelin, D. Joy, A. Romig, C. Lyman, C. Fiori und E. Lifshin. *Scanning electron microscopy and x-ray microanalysis.* Plenum press, New York and London, 1992
- [Gär59] W. W. Gärtner. *Depletion-layer photoeffects in semiconductors.* Phys. Rev., 116 (1959) (1), S. 84

- [Gre82] M. A. Green. *Solar Cells*. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1982
- [Gre01] M. A. Green, K. Emery, D. L. King, S. Igari und W. Warta. *Solar cell efficiency tables (version 17)*. Progress in Photovoltaics, 9 (2001), S. 49
- [Gub68] A. O. Gubeli und J. Ste-Marie. *Formation et stabilité de complexes hydroxo-ammonio en solution aqueuse- Complex de zinc*. Can. J. of Chem., 46 (1968), S. 1707
- [Hab76] J. Haber, J. Stoch und L. Ungier. *X-ray photoelectron spectra of oxygen in oxides of Co, Ni, Fe and Zn*. J. of Elec. Spec. and rel. Phen., 9 (1976), S. 459
- [Hal52] R. N. Hall. *Electron-hole recombination in germanium*. Phys. Rev., 87 (1952), S. 387
- [Har70] H. Hartmann. *On the growth of hexagonal ZnSe single crystals*. Kristall und Technik, 5 (1970), S. 527
- [Har95] D. Hariskos, R. Herberholz, M. Ruckh, U. Rühle, R. Schäffler und H.-W. Schock. *Buffer layers for Cu(In,Ga)(S,Se)₂/BF/ZnO solar cells*. In *Proc. of 13th E-PVSEC*. S. 1995, Nice, France, 1995
- [Has95] Y. Hashimoto, T. Nakanishi, T. Andoh und K. Ito. *CdS thin film deposited in Iodid-containing chemical bath*. Jap. J. Appl. Phys., 34 (1995), S. L382
- [Hei96] J. Heidenreich. *Transmissions-Elektronenmikroskopie (TEM)*. Springer Verlag, Berlin, Heidelberg, New York, 1996
- [Hen00] I. Hengel. *Ladungsträgertransport und Rekombinationsmechanismen in Chalkopyrit-Dünn-schichtsolarzellen*. Dissertation, Freie Universität Berlin (2000)
- [Her97] R. Herberholz. *Spektroskopie elektrischer Defekte in Heteroübergängen auf der Basis von Cu(In,Ga)Se₂*. Dissertation, Universität Stuttgart (1997)
- [Hes97] C. Heske, G. Richter, Z. Chen, R. Fink, E. Umbach, W. Riedl und F. Karg. *Influence of Na and H₂O on the surface properties of Cu(In,Ga)Se₂ thin films*. J. Appl. Phys., 82 (1997), S. 2411
- [Hes99] C. Heske, D. Eich, R. Fink, E. Umbach, T. van Buuren, C. Bostedt, L. J. Terminello, S. Kakar, M. M. Grush, T. A. Callcott, F. J. Himpsel, D. L. Ederer, R. C. C. Perera, W. Riedl und F. Karg. *Observation of intermixing at the buried CdS/Cu(In,Ga)Se₂ thin film solar cell heterojunction*. Appl. Phys. Lett., 74 (1999) (10), S. 1451
- [Hir82] K. Hirokawa und Y. Danzaki. *Behaviour of water containing materials in high vacuum of an x-ray photoelectron spectrometer*. Surf. and Interf. Anal., 4 (1982), S. 63
- [Hoe85] H. Hoelscher, A. Noethe und C. Uihlein. *Investigation of band masses and g values of ZnSe by two-photon magnetoabsorption*. Phys. Rev. B, 31 (1985), S. 2379
- [Hou96] J. Hou, S. Fonash und J. Kessler. *An experimental and computer simulation study of the role of CdS in CIS-type solar cells*. In *Proc. of 25th IEEE*. S. 961, 1996
- [HR92] J. Hernandez-Rojas, M. Lucia, I. Martí, G. Gonzalez-Díaz, J. Santamaría und F. Sanchez-Quesada. *Optical analysis of absorbing thin films: application to ternary chalcopyrite semiconductors*. Applied optics, 31 (1992), S. 1606
- [Hun99] R. Hunger. *Molekularstrahlepitaxie von Kupferindiumsulfid auf Silizium*. Dissertation, Technische Universität Berlin (1999)

- [Hur92] G. Hurx, D. Klaasen und M. Knuvers. *A new recombination model for device simulation including tunneling.* IEEE Trans. Elec. Dev., 39(2) (1992), S. 331
- [Iga00] M. Igelson und P. Zabierowski. *Transient capacitance spectroscopy of defect levels in CIGS devices.* Thin Solid Films, 361 (2000), S. 371
- [Joh67] E. Johnson. *Semiconductor and Semimetals Vol. 3.* Academic Press, 1967
- [JW99] A. Jäger-Waldau, H.-J. Muffler, R. Klenk, M. Kirsch, C. Kelch und M. C. Lux-Steiner. *Gallium doped ZnO for thin film solar cells.* Inst. Phys. Conf. Ser., 162 (1999) (10), S. 565
- [Kar01] F. Karg. *Developement and manufacturing of CIS thin film solar modules.* Solar Energy Materials and Solar Cells, 66 (2001), S. 645
- [Kau02] C. Kaufmann. *Chemical bath deposition of thin semiconductor films for use as buffer layers in CuInS₂ thin film solar cells.* Dissertation, University of Oxford (2002)
- [Kes92] J. Kessler, K. Velthaus, M. Ruckh, R. Laichinger, H.-W. Schock, D. Lincot, R. Ortega und J. Vedel. *Chemical bath deposition of CdS on CuInSe₂, etching effects and growth kinetics.* In Proc. of 6th PVSEC. S. 1005, New Delhi, India, 1992
- [Kes01] F. Kessler, K. Herz, E. Gross, M. Powalla, K.-M. Baumgaertner, A. Schulz und J. Herrero. *CIS Thin-Film Solar Cells on Metal Foils.* In Proc. of 16th E-PVSEC. S. 317, Glasgow, 2001
- [Kit70] G. A. Kitaev und T. P. Sokolova. *Chemical deposition of thin Zinc Selenide films.* Rus. J. of Inorg. Chem, 15 (1970), S. 167
- [Kle77] W. Kleber. *Einführung in die Kristallographie.* VEB Verlag Technik, Berlin, 1977
- [Kle94] R. Klenk und H. W. Schock. *Photocurrent collection in thin film solar cells - calculation and characterization for CuGaSe₂/(Zn,Cd)S.* In Proc. of 12th E-PVSEC. S. 1588, Amsterdam, 1994
- [Kle01] R. Klenk. *Characterization and Modelling of Chalcopyrite Solar Cells.* Thin Solid Films, 387 (2001), S. 135
- [Kön02] M. Köntges, R. Reineke-Koch, P. Nollet, J. Beier, R. Schäffler und J. Parisi. *Light induced changes in the electrical behaviour of CdTe and Cu(In,Ga)Se₂ solar cells.* Thin Solid Films, 403-404 (2002), S. 280
- [Kra96] J. Krauser. *Wasserstoff im MOS-System: Bestimmung der Konzentration, Verteilung und Dynamik des Wasserstoffs mit Hilfe der ¹⁵N-Methode.* Dissertation, Technische Universität Berlin (1996)
- [Kra00] J. Krauser, T. Riedle, J. Klaer, M. Lux-Steiner und A. Weidinger. *Hydrogen concentration in chalcopyrite thin-film solar cells.* Appl. Phys. A, 70 (2000), S. 617
- [Kro98] L. Kronik, D. Cahen und H.-W. Schock. *Effects of sodium on polycrystalline Cu(In,Ga)Se₂ and its solar cell performance.* Adv. Mat., 10,1 (1998), S. 31
- [Kro00] L. Kronik, U. Rau, J.-F. Guillemoles, D. Braunger, H.-W. Schock und D. Cahen. *Interface redox engineering of Cu(In,Ga)Se₂-based solar cells: oxygen, sodium and chemical bath effects.* Thin Solid Films, 361-362 (2000), S. 353
- [Kus00] K. Kushiya und O. Yamase. *Stabilization of PN Heterojunction between Cu(InGa)Se₂ Thin-Film Absorber ZnO Window with Zn(O,S,OH)_x Buffer.* Jap. J. Appl. Phys., 39 (2000) (5A), S. 2577

- [Kyl97] A. Kylnér und M. Wirde. *A high-resolution X-ray photoelectron spectroscopy study of Carbon-Nitrogen Impurity in chemical bath deposited CdS thin films.* Jap. J. Appl. Phys., 36 (1997), S. 2167
- [Kyl99] A. Kylnér. *The Chemical Bath Deposited CdS/Cu(In,Ga)Se₂ Interface as Revealed by X-Ray Photoelectron Spectroscopy.* J. Electrochem. Soc., 146 (1999), S. 1816
- [Lan70] D. W. Langer und C. Vesely. Phys. Rev. B, B2 (1970), S. 4885
- [Lia02] D. Liao und A. Rockett. *Effect of surface orientation on the growth and properties of Cu(In,Ga)Se₂.* In Proc. of 29th IEEE. New Orleans, 2002
- [Lin99] D. Lincot, M. Froment und H. Cachet. *Chemical deposition of chalcogenide thin films from solution, in: Advances in chemical science and engineering.* Hrsg.: R. C. Alkire, D. M. Kolb, Wiley Vch, 1999
- [Lin02] S. Lindner, W. Bohne, A. Jäger-Waldau, M. Lux-Steiner, J. Röhrich und G. Vogl. *Investigations of atomic diffusion at CIGSSe/ZnSe interfaces with heavy ion elastic recoil detection analysis (HI-ERDA).* Thin Solid Films, 404-404 (2002), S. 432
- [Lit86] D. Littrell und B. Tatarchuk. *Hydrazine reduction of transition metal oxides: In situ characterization using x-ray photoelectron spectroscopy.* J. Vac. Sci. Technol. A, 4 (1986), S. 1608
- [Lok98] C. Lokhande, P. Patil, H. Tributsch und A. Ennaoui. *ZnSe thin films by chemical bath deposition method.* Solar Energy Materials and Solar Cells, 55 (1998), S. 379
- [LS91] M. C. Lux-Steiner. *Synthese, optoelektronische Eigenschaften und Anwendungen neuer Halbleiterkristalle.* Habilitation, Universität Konstanz (1991)
- [Mar92] L. G. Mar, P. Y. Timbrell und R. N. Lamb. *An XPS study of zinc oxide thin film growth on copper using zinc acetate as a precursor.* Appl. Phys. Lett., 60 (1992), S. 91
- [Mar95] R. Marquéz und C. Rincón. *On the dielectric constants of A^IB^{II}C₂^VI chalcopyrite semiconductor compounds.* Phys. Stat. Sol. (b), 191 (1995), S. 115
- [Men94] L.-J. Meng, C. P. M. de Sa und M. dos Santos. *Study of the structural properties of ZnO thin films by X-ray photoelectron spectroscopy.* Appl. Sur. Sci., 78 (1994), S. 57
- [Mey99] T. Meyer. *Reversible Relaxationsphänomene im elektrischen Transport von Cu(In,Ga)Se₂.* Dissertation, Universität Oldenburg (1999)
- [Mey02] T. Meyer, F. Engelhardt, J. Parisi und U. Rau. *Spectral dependence and Hall effect of persistent photoconductivity in polycrystalline Cu(In,Ga)Se₂ thin films.* J. Appl. Phys., 91 (2002), S. 5093
- [Mit88] K. Mitchell und H. Liu. *Device analysis of CuInSe₂ solar cells.* In Proc. of 20th IEEE. S. 1461, 1988
- [Mok95] B. Mokili, M. Froment und D. Lincot. *Chemical deposition of zinc hydroxosulfide thin films from zinc (II)-ammonia-thiourea solutions.* Journal de Physique IV, C3 supplement (1995), S. 261
- [Mok96] B. Mokili, Y. Charreire, R. Cortes und D. Lincot. *Extended x-ray absorption fine structure studies of zinc hydroxo-sulphide thin films chemically deposited from aqueous solution.* Thin Solid Films, 288 (1996), S. 21

- [Mor01] M. Morkel, L. Weinhardt, B. Lohmüller, C. Heske, E. Umbach, W. Riedl, S. Zweigart und F. Karg. *Flat conduction-band alignment at the CdS/CuInSe₂ thin-film solar cell heterojunction*. Appl. Phys. Lett., 79 (2001), S. 4482
- [Mou92] J. F. Moulder, W. F. Stickl, P. E. Sobol und K. D. Bomben. *Handbook of X-ray photoelectron spectroscopy*, Ed: J. Chastain. Perkin Elmer Corporation, Eden Prairie, Minnesota, 1992
- [Muf01] H. Muffler. *Umsetzung und Funktionsprinzip eines alternativen Material- und Abscheidekonzepts für Pufferschichten von Solarzellen*. Dissertation, Freie Universität Berlin (2001)
- [Nad99] V. Nadenau, D. Hariskos, H.-W. Schock, M. Krejci, F.-J. Haug, A. Tiwari, H. Zogg und G. Ko storz. *Microstructural study of the CdS/CuGaSe₂ interfacial region in CuGaSe₂ thin film solar cells*. J. Appl. Phys., 85 (1999), S. 534
- [Nad00] V. Nadenau, U. Rau, A. Jasenek und H.-W. Schock. *Electronic properties of CuGaSe₂-based heterojunction solar cells. Part1. Transport analysis*. J. Appl. Phys., 87 (2000), S. 584
- [Nak99] T. Nakada, K. Furumi und A. Kunioka. *High efficiency Cadmium-free Cu(In,Ga)Se₂ thin film solar cells with chemically deposited ZnS buffer layer*. IEEE Trans. Elec. Dev., 46 (1999), S. 2093
- [Nak00a] T. Nakada. *Nano-structural investigations on Cd-doping into Cu(In,Ga)Se₂ thin films by chemical bath deposition process*. Thin Solid Films, 361-362 (2000), S. 346
- [Nak00b] T. Nakada und M. Mizutani. *Improved efficiency of Cu(In,Ga)Se₂ thin film solar cells with chemically deposited ZnS buffer layers by air-annealing-formation of homojunction by solid phase diffusion*. In Proc. of 28th IEEE. Anchorage, Alaska, 2000
- [Nak01] T. Nakada. *Diffusion behaviour and microstructural properties of the CBD-ZnS/CIGS interface boundary*. In Proc. of MRS spring meeting. H7.1.1, San Francisco, 2001
- [Nel93] A. Nelson, C. Schwerdtfeger, S.-H. Wei, A. Zunger, D. Rioux, R. Patel und H. Höchst. *Theoretical and experimental studies of the ZnSe/CuInSe₂ heterojunction offset*. Appl. Phys. Lett., 62 (1993) (20), S. 2557
- [Neu82] H. Neumann, B. Perlt, N. Abdul-Hussein, R. Tomlinson und A. Hill. *Optical properties of CuInSe₂ thin films prepared by r.f. sputtering*. Crystal Res and Technol., 17(4) (1982), S. 469
- [Nie96] A. Niemegeers und M. Burgelman. *Numerical modelling of ac-characteristics of CdTe and CIS solar cells*. In Proc. of 25th IEEE. S. 901, Washington D. C., 1996
- [Nie98a] A. Niemegeers, S. Gillis und M. Burgelman. *Interpretation of capacitance spectra in the special case of novel thin film CdTe/CdS and CIGS/CdS solar cell device structures*. In Proc. of 2nd WCPEC. S. 1071, Vienna, Austria, 1998
- [Nie98b] A. Niemegeers, M. Burgelman, R. Herberholz, U. Rau und D. Hariskos. *Model for electronic transport in Cu(In,Ga)Se₂ solar cells*. Progress in Photovoltaics: Research and Applications, 6 (1998), S. 407
- [Nil97] D. W. Niles, G. Herdt und M. Al-Jassim. *An X-ray photoelectron spectroscopy investigation of O impurity chemistry in CdS thin films grown by chemical bath deposition*. J. Appl. Phys., 81 (1997), S. 1978
- [Nil99] D. W. Niles, M. Al-Jassim und K. Ramanathan. *Direct observation of Na and O impurities at grain surfaces of CuInSe₂ thin films*. J. Vac. Sci. Technol. A, 17 (1999), S. 291

- [OB93] R. Ortega-Borges und D. Lincot. *Mechanism of chemical bath deposition of cadmium sulfide thin films in the ammonia-thiourea system.* J. Electrochem. Soc., 140 (1993), S. 3464
- [O'B00] P. O'Brien, D. J. Otway und D. Smyth-Boyle. *The importance of ternary complexes in defining basic conditions for the deposition of ZnS by aqueous chemical bath deposition.* Thin Solid Films, 361 (2000), S. 17
- [Oka98] Y. Okano, T. Nakada und A. Kunioka. *XPS analysis of CdS/CuInSe₂ heterojunctions.* Solar Energy Materials and Solar Cells, 50 (1998), S. 105
- [Ola99] I. Oladeji und L. Chow. *A study of the effects of ammonium salts on chemical bath deposited zinc sulfide films.* Thin Solid Films, 339 (1999), S. 148
- [Pad66] F. Padovani und R. Stratton. *Field and thermionic-field emission in schottky barriers.* Solid-State Elec., 9 (1966), S. 695
- [Pan75] J. I. Pankove. *Optical Processes in Semiconductors.* Dover Publication, New York, 1975
- [Par85] R. Park, H. Mar und N. Salansky. *Photoluminescence properties of nitrogen-doped ZnSe grown by molecular beam epitaxy.* J. Appl. Phys., 58 (1985), S. 1047
- [Par98] J. Parisi, D. Hilburger, M. Schmitt und U. Rau. *Quantum efficiency and admittance spectroscopy.* Solar Energy Materials and Solar Cells, 50 (1998), S. 79
- [Phi88] J. E. Phillips und M. Roy. *Resistive and photoconductive effects in spectral response measurements.* In *Proc. of 20th IEEE.* S. 1614, 1988
- [Pow01] M. Powalla und B. Dimmler. *First results of the CIGS solar module pilot production.* In *Proc. of 17th E-PVSEC.* S. 983, Munich, Germany, 2001
- [Pro01a] V. Probst, W. Stetter, W. Riedl, H. Vogt, M. Wendl, H. Calwer, S. Zweigart, K.-D. Ufert, B. Freienstein, H. Cerva und F. Karg. *Rapid CIS-process for high efficiency PV-modules: development towards large area processing.* Thin Solid Films, 387 (2001), S. 262
- [Pro01b] V. Probst, W. Stetter, S. Zweigart, M. Wendl, H. Vogt, K.-D. Ufert, H. Calwer, B. Freienstein und F. Karg. *Large area CIS formation by rapid thermal processing of stacked elemental layers.* In *Proc. 17th E-PVSEC.* Munich, Germany, 2001
- [Ram98] K. Ramanathan, H. Wiesner, S. Asher, D. Niles, J. Keane, M. A. Contreras und R. Noufi. *High efficiency Cu(In,Ga)Se₂ thin film solar cells without intermediate buffer layers.* In *Proc. of 2nd WCPEC.* S. 477, Vienna, Austria, 1998
- [Rau98a] U. Rau, A. Jasenek, R. Herberholz, H.-W. Schock, J.-F. Guillemoles, D. Lincot und L. Kronik. *The inherent stability of Cu(In,Ga)Se₂-based solar cells.* In *Proc. of 2nd WCPEC.* S. 428, Vienna, Austria, 1998
- [Rau98b] U. Rau, M. Schmitt, F. Engelhardt, O. Seifert, J. Parisi, W. Riedl, J. Rimmasch und F. Karg. *Impact of Na and S incorporation on the electronic transport mechanisms of Cu(In,Ga)Se₂ Solar Cells.* Solid State Com., 107 (1998), S. 59
- [Rau99a] U. Rau. *Tunneling-enhanced recombination in Cu(In,Ga)Se₂ heterojunction solar cells.* Appl. Phys. Lett., 74 (1999) (1), S. 111
- [Rau99b] U. Rau, D. Braunger, R. Herberholz, H. W. Schock, J.-F. Guillemoles, L. Kronik und D. Cahen. *Oxygenation and air-annealing effects on the electronic properties of Cu(In,Ga)Se₂ films and devices.* J. Appl. Phys., 86 (1999), S. 497

- [Rau99c] U. Rau und H.-W. Schock. *Electronic properties of Cu(In,Ga)Se₂ heterojunction solar cells – recent achievements, current understanding and future challenges.* Appl. Phys. A, 69 (1999), S. 131
- [Rau00] U. Rau, A. Jasenek, H.-W. Schock, F. Engelhardt und T. Meyer. *Electronic loss mechanisms in chalcopyrite based heterojunction solar cells.* Thin Solid Films, 361-362 (2000), S. 298
- [Rau01a] U. Rau und M. Schmidt. *Electronic properties of ZnO/CdS/Cu(In,Ga)Se₂ solar cells - aspects of heterojunction formation.* Thin Solid Films, 387 (2001), S. 141
- [Rau01b] U. Rau, K. Weinert, Q. Nyugen, M. Mamor, G. Hanna, A. Jasenek und H.-W. Schock. *Device analysis of Cu(In,Ga)Se₂ Heterojunction Solar cells - Some open questions.* In Proc. of MRS spring meeting. H9.1.1, San Francisco, 2001
- [Rei03] J. Reiss. *Generation und Rekombination von Ladungsträgern in CuInS₂-basierten Dünnschichtsolarzellen.* Dissertation, Freie Universität Berlin (to be published, 2003)
- [Rho88] E. H. Rhoderick und R. Williams. *Metal-Semiconductor Contacts.* Clarendon, Oxford, 1988
- [Rho93] E. H. Rhoderick, W. R. Frensley und M. P. Shaw. *Device Physics, Editor: T.S. Moss,* Band 4. Elsevier Science Publishers B. V., Amsterdam, 1993
- [Rie90] E. Riedel. *Allgemeine und anorganische Chemie.* Walter de Gruyter, Berlin, 1990
- [Roc00] A. Rockett, J. Britt, T. Gillespie, C. Marshall, M. A. Jassim, F. Hasoon, R. Matson und B. Basol. *Na in selenized Cu(In,Ga)Se₂ on Na-Containing and Na-free glasses: distribution, grain structure, and device performance.* Thin Solid Films, 372 (2000), S. 212
- [Rot78] A. Rothwarf, J. Phillips und N. C. Wyeth. *Junction field and recombination phenomena in the CdS/Cu₂S solar cell: Theory and experiment.* In Proc. of 13th IEEE. S. 399, 1978
- [Rub87] M. N. Ruberto und A. Rothwarf. *Time-dependent open-circuit voltage in CuInSe₂/CdS solar cells: theory and experiment.* J. Appl. Phys., 61 (1987) (9), S. 4662
- [Ruc94] M. Ruckh, D. Schmid und H.-W. Schock. *Photoemission studies of the ZnO/CdS interface.* J. Appl. Phys., 76 (1994) (10), S. 5945
- [Ruc96] M. Ruckh. *Heterostrukturen in Solarzellen auf der Basis von polykristallinem Kupferselenid - Charakterisierung mittels Photoelektronenspektroskopie.* Dissertation, Universität Stuttgart (1996)
- [Rum00] A. Rumberg, C. Sommerhalter, M. Toplak, A. Jäger-Waldau und M. C. Lux-Steiner. *ZnSe thin films grown by chemical vapour deposition for application as buffer layer in CIGSS solar cells.* Thin Solid Films, 361-362 (2000), S. 172
- [Rum01] A. Rumberg. *Chemische Gasphasendeposition von ZnSe-Puffern für die Anwendung in Chalcopyrit-Dünnschichtsolarzellen.* Dissertation, Freie Universität Berlin (2001)
- [Sas93] R. Sasala und J. Sites. *Time dependent voltage in CuInSe₂ and CdTE solar cells.* In Proc. of 23th IEEE. S. 543, 1993
- [Sch69] G. Schimmel. *Elektronenmikroskopische Methodik.* Springer Verlag, Berlin, Heidelberg, New York, 1969
- [Sch93] D. Schmid, M. Ruckh, F. Grunewald und H.-W. Schock. *Chalcopyrite/defect chalcopyrite heterojunctions on the basis of CuInSe₂.* J. Appl. Phys., 73 (1993) (6), S. 2902

- [Sch97] G. Schatz und A. Weidinger. *Nukleare Festkörperphysik*. Teubner, Stuttgart, 1997
- [Sch00] M. Schmitt, U. Rau und J. Parisi. *Charge carrier transport via defect states in Cu(In,Ga)Se₂ thin films and Cu(In,Ga)Se₂/CdS/ZnO heterojunctions*. Phys. Rev. B, 61 (2000), S. 16052
- [Sch01] R. Scheer, I. Luck, M. Kanis, M. Matsui, T. Watanabe und T. Yamamoto. *Incorporation of the doping elements Sn, N, and P in CuInS₂ thin films prepared by co-evaporation*. Thin Solid Films, 392 (2001), S. 1
- [Sho49] W. Shockley. *The theory of p-n junctions in semiconductors and p-n junction transistors*. Bell Syst. Tech. J., 28 (1949), S. 435
- [Sho52] W. Shockley und W. T. Read. *Statistics of the recombination of holes and electrons*. Phys. Rev., 87 (1952), S. 835
- [Sho61] W. Shockley und H. J. Queisser. *Detailed balance limit of efficiency in p-n junction solar cells*. J. Appl. Phys., 32 (1961), S. 510
- [Sil64] L. G. Sillen und A. E. Martell. *Stability constants of metall-ion complexes*. The chemical society, Burlington house, London, 1964
- [Ste00] W. Stetter, V. Probst, H. Vogt, W. Riedl, , M. Wendl, H. Calwer, S. Zweigart, K.-D. Ufert, B. Freienstein und F. Karg. *High efficiency CIS mini-modules produced by rapid annealing of stacked elemental layers*. In *Proc. of 16th E-PVSEC*. Glasgow, UK, 2000
- [Sze81] S. Sze. *Physics of Semiconductor Devices*. Wiley, New York, 1981
- [Tak99] S. Takeuchi und K. Suzuki. *Stacking fault energies of tetrahedrally coordinated crystals*. Phys. Stat. Sol. (a), 171 (1999), S. 99
- [Tob99] S. Tober. *Herstellung und Charakterisierung von Dünnschicht-Solarzellen auf der Basis von CuGaSe₂ und CuInSe₂*. Diplomarbeit, Freie Universität Berlin (1999)
- [Ton00] D. Tonti. *Photoelectron spectroscopy study of the intercalation reaction of alkali metals in transition metal dichalcogenides*. Dissertation, Freie Universität Berlin (2000)
- [Top97] M. Topic, F. Smole und J. Furlan. *Examination of blocking current-voltage behaviour through defect chalcopyrite layer in ZnO/CdS/Cu(In,Ga)Se₂/Mo solar cell*. Solar Energy Materials and Solar Cells, 49 (1997), S. 311
- [Tur02] M. Turcu, I. Kötschau und U. Rau. *Composition dependence of defect energies and band alignments in the Cu(In_{1-x}Ga_x)(Se_{1-x}S_x) alloy system*. J. Appl. Phys., 91 (2002), S. 1391
- [Tut89] J. Tuttle, D. Albin, R. Matson und R. Noufi. *A comprehensive study on the optical properties of thin-film CuInSe₂ as a function of composition and substrate temperature*. J. Appl. Phys., 66 (1989), S. 4408
- [Tya91] M. Tyagi. *Introduction to semiconductor materials and devices*. John Wiley, 1991
- [Ves71] C. J. Vesely und D. W. Langer. Phys. Rev. B, B4 (1971), S. 451
- [Wad97] T. Wada. *Microstructural characterization of high-efficiency Cu(In,Ga)Se₂ solar cells*. Solar Energy Materials and Solar Cells, 49 (1997), S. 249
- [Wad98] T. Wada, S. Hayashi, Y. Hashimoto, S. Nishiwaki, T. Sato, T. Negami und M. Nishitani. *High efficiency Cu(In,Ga)Se₂ solar cells with improved CIGS surface*. In *Proc. of 2nd WCPEC*. S. 403, Vienna, Austria, 1998

- [Wal94] T. Walter. *Herstellung und optoelektronische Charakterisierung polykristalliner I-III-VI₂-Verbindungshalbleiter und darauf basierender Heteroübergänge für Dünnschichtsolarzellen*. Dissertation, Universität Stuttgart (1994)
- [Wal95] T. Walter, D. Hariskos, R. Herberholz, V. Nadenau, R. Schäffler und H.-W. Schock. *On the role of oxidation for the performance of Cu(In,Ga)(S,Se)₂ polycrystalline thin film solar cells*. In *Proc. of 13th E-PVSEC*. S. 1999, Nice, France, 1995
- [Web99] M. Weber, J. Krauser, A. Weidinger, J. Bruns, C.-H. Fischer, W. Bohne, J. Röhrich und R. Scheer. *Hydrogen impurities in chemical bath deposited CdS*. *J. Electrochem. Soc.*, 146(6) (1999), S. 2131
- [Wei93] S.-H. Wei und A. Zunger. *Band offsets at the CdS/CuInSe₂ heterojunction*. *Appl. Phys. Lett.*, 63 (1993) (18), S. 2549
- [Wei95] S.-H. Wei und A. Zunger. *Band offsets and optical bowings of chalcopyrite II-VI alloys*. *J. Appl. Phys.*, 78 (1995), S. 3846
- [Wei01] L. Weinhardt, M. Morkel, T. Gleim, S. Zweigart, T. Niesen, F. Karg, C. Heske und E. Umbach. *Band alignment at the CdS/CuIn(S,Se)₂ heterojunction in thin film solar cells*. In *Proc. of 17th E-PVSEC*. S. 1261, Munich, 2001
- [Woe98] M. Woerz, E. Pschorrer-Schoberer, R. Flierl, H. Preis und W. Gebhardt. *Photoelectron spectroscopy of chalcopyrites and Zn based II-VI semiconductor heterostructures*. *J. Appl. Phys.*, 84 (1998), S. 2871
- [Yeh92] C.-Y. Yeh, Z. Lu, S. Froyen und A. Zunger. *Zinc-blende - wurtzite polytypism in semiconductors*. *Phys. Rev. B*, 46 (1992), S. 10086
- [Yu75] P. Yu, Y. Park, S. Faile und J. Ehret. *Electroluminescence and photovoltaic detection in Cd-implanted CuInSe₂ p-n junction diodes*. *Appl. Phys. Lett.*, 26 (1975), S. 717
- [Yu76] P. Yu, Y. Park und J. Grant. *Electroluminescence in Br-, Cl-, Zn-implanted CuInSe₂ p-n junctions*. *Appl. Phys. Lett.*, 28 (1976), S. 214
- [Zab00] P. Zabierowski und M. Igalsen. *Thermally assisted tunneling in Cu(InGa)Se₂-based photovoltaic devices*. *Thin Solid Films*, 361 (2000), S. 268
- [Zha98] S. Zhang, S.-H. Wei, A. Zunger und H. Katayama-Yoshida. *Defect physics of the CuInSe₂ chalcopyrite semiconductor*. *Phys. Rev. B*, 57 (1998), S. 9642
- [Zur87] P. Zurcher, A. Nelson, P. Johnson, G. Lapeyre und R. Noufi. *Soft X-ray photoemission investigation of the oxidation of CuInSe₂ thin films*. In *Proc. of 19th IEEE*. S. 955, 1987

