

# Literaturverzeichnis

- [1] W.J. Kaiser and L.D. Bell. Direct investigation of subsurface interface electronic structure by ballistic-electron-emission microscopy. *Phys. Rev. Lett.*, 60:1406, 1988.
- [2] M. Prietsch. Ballistic electron emission microscopy (BEEM): Studies of metal/semiconductor interfaces with nanometer resolution. *Physics Reports*, 253:163–233, 1995.
- [3] R. G. Haire and L. Eyring. Comparison of the binary oxides. In Jr. Karl A. Gschneidner, LeRoy Eyring, G.R. Choppin, and G.H. Lander, editors, *Handbook on the Physics and Chemistry of Rare Earths*, volume 18, pages 413–505. North-Holland, Amsterdam, 1994.
- [4] H. J. Osten, E. Bugiel, J. Dabrowski, A. Fissel, T. Guminskaya, J. P. Liu, H. J. Müssig, and P. Zaumseil. Epitaxial praseodymium oxide: A new high-k dielectric. In *Proceedings of the International Workshop on Gate Insulators (IWGI), Tokyo, Nov 2001*, page 100.
- [5] V. Narayananamurti and M. Kozhevnikov. BEEM imaging and spectroscopy of buried structures in semiconductors. *Physics Reports*, 349:447–514, 2001.
- [6] R. Ludeke. Hot-electron effects and oxide degradation in MOS structures studied with ballistic electron emission microscopy. *IBM J. Res. Develop.*, 44:517, 2000.
- [7] W. H. Rippard and R. A. Buhrman. Spin-dependent hot electron transport in Co/Cu thin films. *Phys. Rev. Lett.*, 84:971, 2000.
- [8] W. H. Rippard, A. C. Perrella, F. J. Albert, and R. A. Buhrman. Ultrathin aluminum oxide tunnel barriers. *Phys. Rev. Lett.*, 88:46805, 2002.
- [9] C. Troadec, L. Kunardi, and N. Chandrasekhar. Ballistic emission spectroscopy and imaging of a buried metal/organic interface. *Appl. Phys. Lett.*, 86:072101, 2005.
- [10] L. D. Bell and W. J. Kaiser. Ballistic-electron emission microscopy: A nanometer-scale probe of interfaces and carrier transport. *Annu. Rev. Mater. Sci.*, 26:189, 1996.
- [11] P. L. de Andres, F. J. Garcia-Vidal, K. Reuter, and F. Flores. Theory of ballistic electron emission microscopy. *Progress in Surface Science*, 66:3–51, 2001.

## Literaturverzeichnis

- [12] Ballistic Electron Emission Microscopy Publications, listed by Research Group.  
[http://dbell.jpl.nasa.gov/beem/b\\_pubs.htm](http://dbell.jpl.nasa.gov/beem/b_pubs.htm).
- [13] R. Ludeke and A. Bauer. Electrical transport properties of hot electrons at metal, insulator and semiconductor interfaces. *J. Vac. Sci. Technol. A*, 13:614, 1995.
- [14] L. D. Bell and W. J. Kaiser. Observation of interface band structure by ballistic-electron-emission microscopy. *Phys. Rev. Lett.*, 61:2368, 1988.
- [15] J. G. Simmons. Generalized thermal J-V- characteristic for the electric tunnel effect. *J. Appl. Phys.*, 35:2655, 1964.
- [16] M. Prietsch and R. Ludeke. Ballistic-electron-emission microscopy and spectroscopy of GaP(110)-metal interfaces. *Phys. Rev. Lett.*, 66:2511, 1991.
- [17] M. T. Cuberes, A. Bauer, H. J. Wen, D. Vandr  , M. Prietsch, and G. Kaindl. Ballistic-electron emission microscopy on the Au/n-Si(111)7x7 interface. *J. Vac. Sci. Technol. B*, 12:2422, 1994.
- [18] O. Kurnosikov, J. E. A. de Jong, H. J. M. Swagten, and W. J. M. de Jonge. Direct observation of local hot electron transport through Al<sub>2</sub>O<sub>3</sub> tunnel junctions. *Appl. Phys. Lett.*, 80:1076, 2002.
- [19] H. L  th. *Surfaces and Interfaces of Solids*, volume 15 of *Springer Series in Surface Sciences*. Springer Verlag, Berlin, 1993.
- [20] E. H. Rhoderick and R. H. Williams. *Metal-Semiconductor Contacts*. Clarendon Press, Oxford, 1988.
- [21] A. Bauer. *Das Transportverhalten hei  er Elektronen an Metall-Halbleiterkontakten untersucht mit Ballistische-Elektronen-Emissions-Mikroskopie (BEEM)*. Dissertation, Freie Universit  t Berlin, 1993.
- [22] S. M. Sze. *Physics of Semiconductor Devices*. Wiley, New York, 2nd edition, 1984.
- [23] M. T. Cuberes, A. Bauer, H. J. Wen, M. Prietsch, and G. Kaindl. Ballistic-electron emission microscopy study of the Au/Si(111)7x7 and Au/CaF<sub>2</sub>/Si(111)7x7 interfaces. *Appl. Phys. Lett.*, 84:2300, 1994.
- [24] R. Ludeke, A. Bauer, and E. Cartier. Hot electron transport in SiO<sub>2</sub> probed with a scanning tunnel microscope. *Appl. Phys. Lett.*, 66:730, 1995.
- [25] H. J. Wen, R. Ludeke, D. M. Newns, S. H. Lo, and E. Cartier. Atomic-scale studies of electron transport through MOS structures. *Appl. Surf. Sci.*, 123:418, 1998.

- [26] B. Kaczer, Z. Meng, and J. P. Pelz. Nanometer-scale creation and characterization of trapped charge in SiO<sub>2</sub> films using ballistic electron emission microscopy. *Phys. Rev. Lett.*, 77:91, 1996.
- [27] B. Kaczer, H.-J. Im, and J. P. Pelz. Investigation of ultrathin SiO<sub>2</sub> film thickness variations by ballistic electron emission microscopy. *J. Vac. Sci. Technol. B*, 16:2302, 1998.
- [28] A. Chahboun, R. Coratger, A. Pascale, P. Baules, F. Ajustron, I. Zorkani, and J. Beauvillain. Controlled modifications of electron injection on Au/Si and Au/SiO<sub>2</sub>/Si contacts using ballistic electron emission microscopy. *J. Appl. Phys.*, 89:6302, 2001.
- [29] C. Girardin, R. Coratger, R. Pechou, F. Ajustron, and J. Beauvillain. Study of the electron mean free path by ballistic electron emission microscopy. *J. Phys. III France*, 6:661, 1996.
- [30] R. Ludeke, E. Cartier, and Andreas Schenk. Determination of the energy-dependent conduction band mass in SiO<sub>2</sub>. *Appl. Phys. Lett.*, 75:1407, 1999.
- [31] R. Ludeke, M. T. Cuberes, and E. Cartier. Local transport and trapping issues in Al<sub>2</sub>O<sub>3</sub> gate oxide structures. *Appl. Phys. Lett.*, 76:2886, 2000.
- [32] A. C. Perella, W. H. Rippard, P. G. Mather, M. J. Plisch, and R. A. Buhrman. Scanning tunneling spectroscopy and ballistic electron emission microscopy studies of aluminum-oxide surfaces. *Phys. Rev. B*, 65:201403(R), 2002.
- [33] K. Hata, T. Kimura, S. Ozawa, and H. Shigekawa. How to fabricate a defect free Si(001) surface. *J. Vac. Sci. Technol. A*, 18:1933, 2000.
- [34] Gmelin. *Handbook of Inorganic Chemistry*. SEC1, Springer, Berlin, 8. Aufl., 1974.
- [35] C. Schüssler-Langeheine. *Magnetic Properties of Thin Films of Heavy Lanthanide Metals Studied by Magnetic X-Ray Diffraction and High-Resolution Photoemission*. Dissertation, Freie Universität Berlin, 1999.
- [36] omicron. *EFM Manual, Anhang A*, 2.2 edition, 1999.
- [37] H-J. Müssig. private Mitteilung.
- [38] X. Guo, W. Braun, B. Jenichen, and K. H. Ploog. Reflection high-energy electron diffraction study of molecular beam epitaxy growth of Pr<sub>2</sub>O<sub>3</sub> on Si(100). *Journal of Crystal Growth*, 290:73, 2006.
- [39] A. M. Shikin, D. V. Vyalikh, Y. S. Dedkov, G. V. Prudnikova, V. K. Adamchuk, E. Weschke, and G. Kaindl. Extended energy range of Ag quantum-well states in Ag(111)/Au(111)/W(110). *Phys. Rev. B*, 62:R2303, 2000.

## Literaturverzeichnis

- [40] M. K. Weilmeier, W. H. Rippard, and R. A. Buhrman. Ballistic electron transport through Au(111)/Si(111) and Au(111)/Si(100) interfaces. *Phys. Rev. B*, 59:R2521, 1999.
- [41] M. Dähne-Prietsch and T. Kalka. Hot-electron transport processes in ballistic-electron emission microscopy at Au-Si interfaces. *Journal of Electron Spectroscopy and Related Phenomena*, 109:211, 2000.
- [42] F. J. Garcia-Vidal, P. L. de Andres, and F. Flores. Elastic scattering and the lateral resolution of ballistic electron emission microscopy: Focusing effects on the Au/Si interface. *Phys. Rev. Lett.*, 76:807, 1996.
- [43] M. K. Weilmeier. *Ballistic Electron Emission Microscopy and Metallic Band structure effects*. PhD thesis, Cornell University, 1998.
- [44] A. Fernandez, H. D. Hallen, T. Huang, R. A. Buhrman, and J. Silcox. Ballistic electron studies and modification of the Au/Si(111) interface. *Appl. Phys. Lett.*, 57:2826, 1990.
- [45] S. Heike, S. Watanabe, Y. Wada, and T. Hashizume. Electron conduction through surface states of the Si(111)-(7x7) surface. *Phys. Rev. Lett.*, 81:890, 1998.
- [46] C. Grupp and A. Taleb-Ibrahimi. Au/H:Si(111)-(1x1) interface versus Au/Si(111)-(7x7). *Phys. Rev. B*, 57:6258, 1998.
- [47] H. Winnefeld, M. Czanta, G. Fahsold, H. J. Jänsch, G. Kirchner, W. Mannstadt, J. J. Paggel, R. Platzer, R. Schillinger, R. Veith, C. Weindel, and D. Fick. Growth of the room temperature Au/Si(111)-(7x7) interface. *Phys. Rev. Lett.*, 70:3768, 1993.
- [48] M. Wilde and K. Fukutani. Low-temperature growth of Au on H-terminated Si(111): Instability of hydrogen at the Au/Si interface revealed by non-destructive ultra-shallow H-depth profiling. *Jpn. J. Appl. Phys.*, 42:4650, 2003.
- [49] S. Miyazaki, J. Schäfer, J. Ristein, and I. Ley. Surface fermi level position of hydrogen passivated Si(111) surfaces. *Appl. Phys. Lett.*, 68:1247, 1996.
- [50] W. H. Rippard. *Ballistic Electron Magnetic Microscopy: Hot- Electron Transport studies and magnetic imaging of ferromagnetic multilayer films, nanostructures, and tunnel junctions*. PhD thesis, Cornell University, 2001.
- [51] T. Kalka. *Aufbau eines Tieftemperatur-UHV-Rastertunnelmikroskops für Ballistische-Elektronen-Emissions-Mikroskopie*. Diplomarbeit, Freie Universität Berlin, 1995.
- [52] J. P. Sullivan, R. T. Tung, F. Schrey, and W. R. Graham. Correlation of the interfacial structure and electrical properties of epitaxial silicides on Si. *J. Vac. Sci. Technol. A*, 10:1959, 1992.

- [53] R. T. Tung. Recent advances in Schottky barrier concepts. *Materials Science and Engineering*, R 35:1–138, 2001.
- [54] K. Yoo and H. H. Weitering. Electrical conductance of reconstructed silicon surfaces. *Phys. Rev. B*, 65:115424, 2002.
- [55] S. Hasegawa and F. Grey. Electronic transport at semiconductor surfaces-from point-contact transistor to micro-four-point probes. *Surf. Sci.*, 500:84, 2002.
- [56] S. Heike, S. Watanabe, Y. Wada, and T. Hashizume. Control of surface current on a Si(111) surface by using nanofabrication. *Jpn. J. Appl. Phys.*, 38:3866, 1999.
- [57] Y. Hasegawa, I.-W. Lyo, and P. Avouris. Measurement of surface state conductance using STM point contacts. *Surf. Sci.*, 357-358:32, 1996.
- [58] J. Dabrowski and H.-J. Müssig. *Silicon Surfaces and Formation of Interfaces*. World Scientific, Singapore, 2000.
- [59] L. E. Davis, N. C. MacDonald, P. W. Palmberg, G. E. Riach, and R. E. Weber. *Handbook of Auger Electron Spectroscopy*. Physical Electronics Ind. Inc., Eden Prairie, second edition, 1976.
- [60] J. Robertson. High dielectric constant oxides. *Eur. Phys. J. Appl. Phys.*, 28:265, 2004.
- [61] J. Robertson. High dielectric constant gate oxides for metal oxide Si transistors. *Rep. Prog. Phys.*, 69:327, 2006.
- [62] K. Kakushima, K. Tsutsui, S.-I. Ohmi, P. Ahmet, V. R. Rao, and H. Iwai. Rare earth oxides in microelectronics. In Marco Fanciulli and Giovanna Scarel, editors, *Rare Earth Oxide Thin Films*, volume 106 of *Topics in Applied Physics*, page 345. Springer Verlag Heidelberg, 2007.
- [63] G. Bersuker and P. Zeitzoff. Requirements of oxides as gate dielectrics for CMOS devices. In Marco Fanciulli and Giovanna Scarel, editors, *Rare Earth Oxide Thin Films*, volume 106 of *Topics in Applied Physics*, page 367. Springer Verlag Heidelberg, 2007.
- [64] T. Busani and R. A. B. Devine. The importance of network structure in high-k dielectrics: LaAlO<sub>3</sub>, Pr<sub>2</sub>O<sub>3</sub>, and Ta<sub>2</sub>O<sub>5</sub>. *J. Appl. Phys.*, 98:044102, 2005.
- [65] U. Schwalke and Y. Stefanov. Process integration and nanometer-scale electrical characterization of crystalline high-k gate dielectrics. *Microelectronics Reliability*, 45:790, 2005.

## Literaturverzeichnis

- [66] A. U. Mane, Ch. Wenger, G. Lupina, T. Schroeder, G. Lippert, R. Sorge, P. Zaumseil, G. Weidner, J. Dabrowski, and H.-J. Müssig. Process integration of Pr-based high-k gate dielectrics. *Microelectronic Engineering*, 82:148, 2005.
- [67] Ch. Wenger, J. Dabrowski, P. Zaumseil, R. Sorge, P. Formanek, G. Lippert, and H.-J. Müssig. First investigation of metal-insulator-metal (mim) capacitor using  $\text{Pr}_2\text{O}_3$  dielectrics. *Materials Science in Semiconductor Processing*, 7:227, 2004.
- [68] H. J. Osten, J. P. Liu, E. Bugiel, H. J. Müssig, and P. Zaumseil. Growth of crystalline praseodymium oxide on silicon. *Journal of Crystal Growth*, 235:229, 2002.
- [69] J. P. Liu, P. Zaumseil, E. Bugiel, and H. J. Osten. Epitaxial growth of  $\text{Pr}_2\text{O}_3$  on Si(111) and the observation of a hexagonal to cubi phase transition during postgrowth  $\text{N}_2$  annealing. *Appl. Phys. Lett.*, 79:671, 2001.
- [70] H. D. B. Gottlob, M. C. Lemme, T. Mollenhauer, T. Wahlbrink, J. K. Efavi, H. Kurz, Y. Stefanov, K. Haberle, R. Komaragiri, T. Ruland, F. Zaunert, and U. Schwalke. Introduction of crystalline high-k gate dielectrics in a CMOS process. *Journal of Non-Crystalline Solids*, 351:1885, 2005.
- [71] R. Lo Nigro, V. Rainieri, C. Bongiorno, R. Toro, G. Malandrino, and I. L. Fragala. Dielectric properties of  $\text{Pr}_2\text{O}_3$  high-k films grown by metalorganic chemical vapor deposition on silicon. *Appl. Phys. Lett.*, 83:129, 2003.
- [72] K. Kukli, M. Ritala, T. Pilvi, T. Sajavaara, M. Leskelä, A. C. Jones, H. C. Aspinall, D. C. Gilmer, and P. J. Tobin. Evaluation of a praseodymium precursor for atomic layer deposition of oxide dielectric films. *Chem. Mater.*, 16:5162, 2004.
- [73] H. J. Osten. private Mitteilung.
- [74] D. Schmeißer, H.-J. Müssig, and J. Dabrowski. Silicate layer formation at  $\text{Pr}_2\text{O}_3$ /Si(001) interfaces. *Appl. Phys. Lett.*, 85:88, 2004.
- [75] T. Schroeder, T.-L. Lee, J. Zegenhagen, C. Wenger, P. Zaumseil, and H.-J. Müssig. Structure and thickness-dependent lattice parameters of ultrathin epitaxial  $\text{Pr}_2\text{O}_3$  films on Si(001). *Appl. Phys. Lett.*, 85:1229, 2004.
- [76] H. J. Osten, J. P. Liu, and H. J. Müssig. Band gap and band discontinuities at crystalline  $\text{Pr}_2\text{O}_3/\text{Si}(001)$  heterojunctions. *Appl. Phys. Lett.*, 80:297, 2002.
- [77] H. J. Osten, J. P. Liu, E. Bugiel, H. J. Müssig, and P. Zaumseil. Epitaxial growth of praseodymium oxide on silicon. *Materials Science and Engineering B*, 87:297, 2001.

- [78] T. Schroeder, T.-L. Lee, L. Libralesso, I. Jourmard, J. Zegenhagen, P. Zaumseil, C. Wenger, G. Lupina, J. Dabrowski, and H.-J. Müssig. Structure and strain relaxation mechanisms of ultrathin epitaxial  $\text{Pr}_2\text{O}_3$  films on Si(111). *J. Appl. Phys.*, 97:074906, 2005.
- [79] L. Libralesso, T. Schroeder, T.-L. Lee, and J. Zegenhagen. Initial stages of the epitaxial growth of  $\text{Pr}_2\text{O}_3$  on Si(111) studied by LEED and STM. *Surf. Sci.*, 598:L347, 2005.
- [80] E. J. Tarsa, J. S. Speck, and Mcd. Robinson. Pulsed laser deposition of epitaxial silicon/h- $\text{Pr}_2\text{O}_3$ /silicon heterostructures. *Appl. Phys. Lett.*, 63:539, 1993.
- [81] D. K. Fork, D. B. Fenner, and T. H. Geballe. Growth of epitaxial  $\text{PrO}_2$  thin films on hydrogen terminated Si(111) by pulsed laser deposition. *J. Appl. Phys.*, 68:4316, 1990.
- [82] A. Fissel, H. J. Osten, and E. Bugiel. Towards understanding epitaxial growth of alternative high-k dielectrics on Si(001): Application to praseodymium oxide. *J. Vac. Sci. Technol. B*, 21:1765, 2003.
- [83] N. Singh, S. M. Saini, T. Nautiyal, and S. Auluck. Electronic structure and optical properties of rare earth sesquioxides ( $R_2\text{O}_3$ , R= La, Pr, and Nd). *J. Appl. Phys.*, 100:083525, 2006.
- [84] A. I. Shelykh, A. V. Prokofiev, and B. T. Melekh. Band gap variation in  $\text{Ln}_2\text{X}_3$  compounds (Ln=rare earth element, X = O, S, Se). *Phys. Solid State*, 38:236, 1996.
- [85] J. Robertson and K. Xiong. Electronic stucture and band offsets of lanthanide oxides. In Marco Fanciulli and Giovanna Scarel, editors, *Rare Earth Oxide Thin Films*, volume 106 of *Topics in Applied Physics*, page 313. Springer Verlag Heidelberg, 2007.
- [86] J. Viernow, D. Y. Petrovykh, A. Kirakosian, J.-L. Lin, F. K. Men, M. Henzler, and F. J. Himpsel. Chemical imaging of insulators by STM. *Phys. Rev. B*, 59:10356, 1999.
- [87] S. Schintke, S. Messerli, M. Pivetta, F. Patthey, L. Libioulle, M. Stengel, A. De Vita, and W.-D. Schneider. Insulator at the Ultrathin Limit: MgO on Ag(001). *Phys. Rev. Lett.*, 87:276801, 2001.
- [88] J. Kwo, M. Hong, A. R. Kortan, K. T. Queeney, Y. J. Chabal, J. P. Mannaerts, T. Boone, J. J. Krajewski, A. M. Sergent, and J. M. Rosamilia. High e gate dielectrics  $\text{Gd}_2\text{O}_3$  and  $\text{Y}_2\text{O}_3$  for silicon. *Appl. Phys. Lett.*, 77:130, 2000.
- [89] A. Fissel, D. Kühne, E. Bugiel, and H. J. Osten. Cooperative solid-vapor-phase epitaxy: An approach for fabrication of single-crystalline insulator/Si/insulator nanostructures. *Appl. Phys. Lett.*, 88:153105, 2006.

## Literaturverzeichnis

- [90] E. Bugiel, H.J. Osten, A. Fissel, O. Kirlfel, and M. Czernohorsky. TEM investigations of epitaxial high-k dielectrics on silicon. In *Microscopy of Semiconducting Materials*, volume 107 of *Springer Proceedings in Physics*, page 343, 2005.
- [91] M. Hong, A. R. Kortan, P. Chang, Y. L. Huang, C. P. Chen, H. Y. Chou, H. Y. Lee, J. Kwo, M.-W. Chu, C. H. Chen, L. V. Goncharova, E. Garfunkel, and T. Gustafsson. High-quality nanothickness single-crystal  $\text{Sc}_2\text{O}_3$  film grown on Si(111). *Appl. Phys. Lett.*, 87:251902, 2005.
- [92] H. S. Craft, R. Collazo, Z. Sitar, and J. P. Maria. Molecular beam epitaxy of  $\text{Sm}_2\text{O}_3$   $\text{Dy}_2\text{O}_3$  and  $\text{Ho}_2\text{O}_3$  on Si(111). *J. Vac. Sci. Technol. B*, 24:2105, 2006.