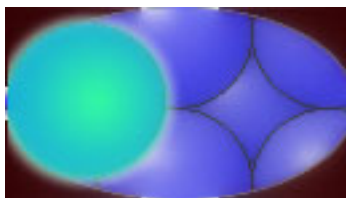
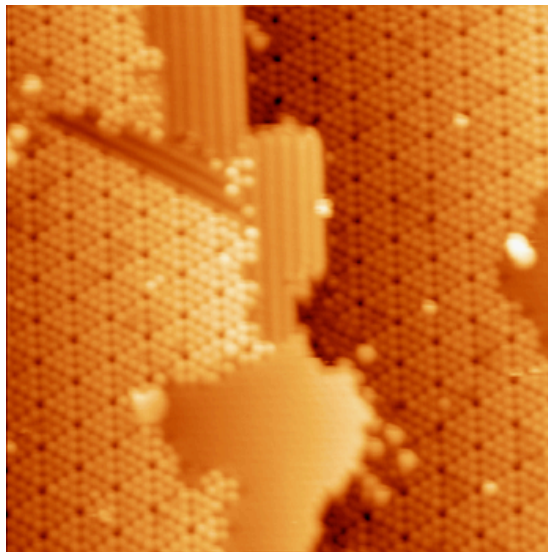


ACTIVITY REPORT
PHYSICS OF MATERIALS AND SURFACES
2001 - 2005



LABORATORY OF MATERIALS PHYSICS

Department of Physics

University of Turku

INTRODUCTION

Research of surfaces, interfaces and control of the thin film growth have its origin in vacuum technology and in the development of surface-sensitive probes such as surface spectroscopies and electron diffraction techniques. In the control of the growth and properties of thin films, surfaces and interfaces there have been impressive gains in technological applications; semiconductors, artificially structured materials, catalysts, corrosion research etc. Both technology and the desire for fundamental knowledge at the atomic level are driven the search for the control of fabrication processes for novel materials and new devices. Thus the studies of film growth, surfaces and interfaces have been increasingly characterized by application of surface science methods to understanding phenomena at the atomic level.

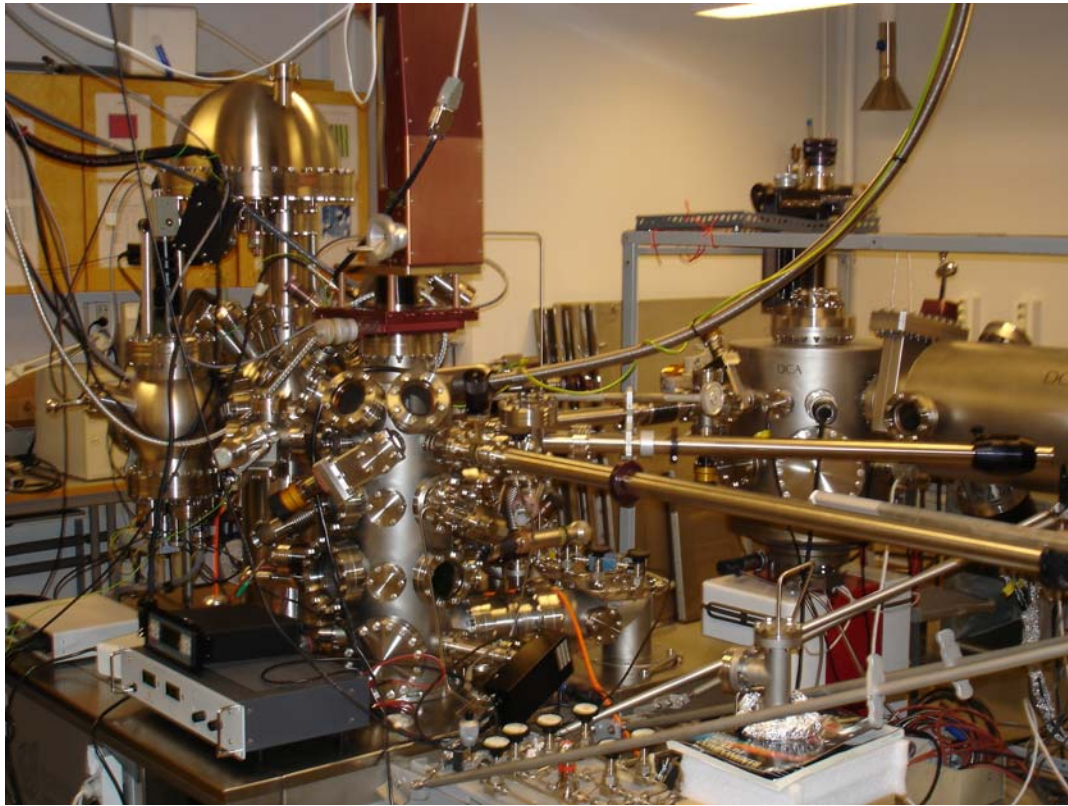
In surface science methods, which previously were used quite often separately, there has been tendency during last years to integrate them into the same UHV to achieve higher control of analyzing conditions of a sample with several methods. This could be called a multiprobe system. On this line we have upgraded during 1990's our equipment in electron spectroscopy and surface physics to improve and increase research possibilities. As a part of instrumentation project "Inverse photoemission spectrometer" (KRIPES) has been realised with the support of Technology Development Centre (TEKES) and industry. Besides these actions we have bought Surface Science System including XPS, UPS, LEED, QMS, UHV AFM/STM, and combined these with KRIPES and sample preparation options all in ultra high vacuum. Thus the experimental research methods available in our home laboratory form an excellent combination for surface science. Furthermore, the contract between The Finnish Consortium and MAX-LAB (Sweden) has been crucial for the activity of synchrotron radiation based research of our group. This contract guarantees a certain amount of beam time to the Finnish users. It was written in return for the investments of Academy of Finland, University of Oulu and University of Turku to a synchrotron beam line at MAX-LAB.

A very challenging research field in surface science is nowadays devoted to materials of reduced dimensionality such as ultrathin films, stripes or chains of atoms, called nanoscale structures. To produce such structures using patterned substrates like self-ordered substrates as templates for guiding the growth process or with the aid of self-assembled adsorbate atoms forming a mask for deposition of atoms are particularly appealing. Spontaneous formation of self-ordered structures can be considered as a promising alternative to lithography techniques in applications for the epitaxial growth. Study of arrays of nanowires, periodic domains and replicated structural periodicities with specific physical properties (e.g. metallic conductivity, magnetic state, optoelectronic response) raises hopes for a possibility of incorporating these into contemporary silicon and compound semiconductor technology

Research field of our group is the physics of materials, surfaces, interfaces, nanostructures and thin films. Atomic and electronic structures and their effects on the physical and chemical properties of materials are studied. Applied research includes materials of metal, electronic and chemical industries.

INSTRUMENTATION

SURFACE SCIENCE SYSTEM (home laboratory)



MAX SYNCHROTRON LABORATORY (Lund, Sweden)



PERSONNEL (December 2005)

- Juhani Väyrynen, Dr. Tech., Professor, Group Leader
- Marko Punkkinen, PhD, Research Associate (teaching assistant)
- Hannu Karhu, PhD, Research Associate (teaching assistant)
- Pekka Laukkanen, PhD, Research Associate
- Riitta Perälä, MSc, Research Associate
- Dina Chichova, MSc, Research Associate (NGSMP)
- Marja Ahola, MSc, Research Associate
- Janne Pakarinen, Student
- Olli-Pekka Hämäläinen, Student
- Erno Airiskallio, Student
- Hannu Ollila, Technician

GRADUATE SCHOOLS

- (GSMR) Graduate School of Materials Research
- (NGSMP) National Graduate School in Materials Physics

DOCTORAL THESIS

“Vacuum ultraviolet grating inverse photoemission spectrometer: Instrumentation and applications” of Phil.Lic. Tapio Ollonqvist, 2001. (Physics)

“XPS studies of alumina supported Pt, Pd, and CuO catalysts with Ba, La and Ce modifiers” of Hannu Karhu, 2002. (Physics)

“Influence of SiC oxidation on electrochemical codeposition of SiC particles with nickel” of MSc Robert Socha, 2003. (Materials Science)

“Rare-earth metal induced nanoscale structures on Si(111) surfaces studied by scanning tunneling microscopy and low energy electron diffraction” of MSc Riikka-Liisa Vaara, 2004. (Physics)

“Atomic and electronic properties of GaAs(100) and InAs(100) semiconductor surfaces “ of DI Pekka Laukkanen, 2005. (Physics)

PROJECTS

- Synchrotron radiation in surface physics (Academy of Finland)
- Nanostructures and thin films on silicon single crystals (Academy of Finland, NGSMP)
- Nanoscale surface studies of GaAs and related materials (Academy of Finland, GSMR)
- Catalysts research with surface sensitive spectroscopies (Academy of Finland)
- Computational research of electronic structure of materials
- Studies of thin films and electronic structure of chalcogen crystal surfaces

- Surface and thin film analysis on stainless steels and copper (VTT, --2005)
- Some short term projects with industry and with university research groups.

COLLABORATION

- MAX-LAB, Synchrotron Radiation Laboratory, Lund, Sweden
- Department of Physics and Measurement Technology, Linköping University, Sweden
- A.F. Ioffe Physico-Technical Institute, St. Petersburg University, Russia
- Institute of Physics, University of Tartu, Estonia
- Laboratory of Industrial Chemistry, Åbo Akademi
- Mass and Heat Transfer Laboratory, University of Oulu
- Laboratory of Materials Processing and Powder Metallurgy, HUT
- Industrial Systems, Surface Film Electrochemistry, VTT
- Polish Academy of Sciences, Lodz, Poland
- Some other short term contacts in Finland and in foreign countries

PAPERS WITH REFEREE PRACTICE AND REPORTS

2001

Papers

M.P.J. Punkkinen, K. Kokko and I.J. Väyrynen: The electronic structure of K_2NiF_4 and K_2CoF_4 : beyond LSDA. - Solid State Communications 117, 583 – 588 (2001).

F. Klingstedt, A.K. Neyestanaki, R. Byggningsbacka, L.-E. Lindfors, M. Lunden, M. Petersson, P. Tengstrom, T. Ollonqvist and J. Väyrynen: Palladium based catalysts for exhaust aftertreatment of natural gas powered vehicles and biofuel combustion. - Applied Catalysis, A: General 209(1,2), 301-316 (2001).

E. Toukoniitty, P. Mäki-Arvela, A. Kalantar Neyestanaki, T. Salmi, R. Sjöholm, R. Leino, E. Laine, P.J. Kooyman, T. Ollonqvist and J. Väyrynen: Batchwise and continuous enantioselective hydrogenation of 1-phenyl-1,2-propandione catalyzed by new Pt/SiO₂ fibers. - Applied Catalysis A: General 216, 73 – 83 (2001).

M. Ferrandon, B. Ferrand, E. Björnbom, F. Klingstedt, A. Kalantar Neyestanaki, H. Karhu, and I.J. Väyrynen: Copper Oxide-Platinum/Alumina Catalyst for Volatile Organic Compound and Carbon Monoxide Oxidation: Synergetic Effect of Cerium and Lanthanum. - Journal of Catalysis 202, 354 - 366 (2001).

E. Toukoniitty, B. Sevcikova, N. Kumar, P. Mäki-Arvela, T. Salmi, J. Väyrynen, T. Ollonqvist, E. Laine, P.J. Kooyman and D. Yu. Murzin: Synthesis and characterization of mesoporous Pt-MCM-41 and its application in enantioselective hydrogenation of 1-phenyl-1,2-propanedione. - Studies in Surface Science and Catalysis 135, 3751 – 3758 (2001).

Reports

R.E. Perälä, T.E. Ollonqvist, M.P.M. Kivitörmä, R.-L. Vanne and I.J. Väyrynen: Sn 4d photoemission study of Sn monolayers on vicinal Si(100)2x1 surface. - MAX-LAB Activity Report 2000, pp 92 - 93, Eds. J.N. Andersen, U. Johansson, R. Nyholm and H. Ullman, Tryckning. KFS AB, Lund, Sweden, 2001.

2002

Papers

F. Klingstedt, H. Karhu, A. Kalantar Neyestanaki, L.-E. Lindfors, T. Salmi and J. Väyrynen: Barium Promoted Palladium Catalysts for the Emission Control of Natural Gas Driven Vehicles and Biofuel Combustion Systems. - Journal of Catalysis 206(2), 248 – 262 (2002).

P.O. Thevenin, E. Pocoroba, L.J. Pettersson, H. Karhu, I.J. Väyrynen and S.G. Järas: Characterization and Activity of Supported Palladium Combustion Catalysts. – Journal of Catalysis 207(1), 139 – 149 (2002).

T.-K. Rantakylä, T. Salmi, J. Kuusisto, P. Mäki-Arvela, T. Ollonqvist, J. Väyrynen and L.P. Lindfors: Hydrogenation of 2,2-Dimethylol-1-butanal and 2,2-Dimethylol-1-propanal to Trimethylolpropane and Trimethylolethane over a Supported Nickel Catalyst. – Industrial & Engineering Chemistry Research 41(3), 524 – 530 (2002).

R.E. Perälä, T.E. Ollonqvist, M.P.M. Kivitörmä and I.J. Väyrynen: Photoemission Study of Sn on Vicinal Si(100)2x1 Surface. - Surface Science, 507 – 510, 213 – 217 (2002).

M. Kuzmin, P. Laukkanen, R.-L. Vanne and I.J. Väyrynen: An Effect of Vicinal Surface Morphology on Adsorbate Structure: Yb Growth on [112]-tilt Si(111). – Surface Science, 515, 471 – 482 (2002).

K. Rahkamaa-Tolonen, T. Salmi, D.Yu. Murzin, L. Baretto Dillon, H. Karhu, R.L. Keiski and J. Väyrynen: Investigation of the NO Reduction by H₂ on Pd-monolith with Transient and Isotopic Exchange Techniques Part I: H₂/D₂ Exchange with H₂O and NH₃. - Journal of Catalysis, 210(1), 17 – 29 (2002).

A. Bernas, P. Laukkanen, N. Kumar, P. Mäki-Arvela, J. Väyrynen, E. Laine, B. Holmbom, T. Salmi and D. Yu. Murzin: A New Heterogeneously Catalytic Pathway for Isomerization of Linoleic Acid over Ru/C and Ni/H-MCM-41 Catalysts. – Journal of Catalysis, 210, 354 – 366 (2002).

M. Lindroos, P. Mäki-Arvela, N. Kumar, T. Salmi, D. Yu. Murzin, T. Ollonqvist and J. Väyrynen: Catalyst Deactivation in Selective Hydrogenation of β -Sitosterol to β -Sitostanol over Palladium. – Catalysis of Organic Reactions, Editor: Morrell, Marcel Dekker Inc., Ch. 50, 587 – 594 (2002).

A. Kalantar Neyestanaki, P. Mäki-Arvela, H. Backman, H. Karhu, T. Salmi, J. Väyrynen, and D.Yu. Murzin: Kinetics and stereoselectivity of o-xylene

hydrogenation over Pd/Al₂O₃. – Journal of Molecular Catalysis A: Chemical 3779, 1 – 14 (2002).

P. Mäki-Arvela, L.-P. Tiainen, M. Lindblad, K. Demirkan, N. Kumar, R. Sjöholm, T. Ollonqvist, J. Väyrynen, T. Salmi and D. Yu. Murzin: Liquid-phase hydrogenation of citral for production of citronellol: catalyst selection. – Applied Catalysis A: General 6362, 1 – 18 (2002).

J. Hajek, N. Kumar, H. Karhu, L. Cerveny, J. Väyrynen, T. Salmi and D. Yu. Murzin: Preparation and properties of bimetallic Ru-Sn sol-gel catalysts. – Studies in Surface Science and Catalysis 143, 757 – 765 (2002).

Reports

R.E. Perälä, R.L. Vanne, P. Laukkanen, M. Kuzmin and I.J. Väyrynen: Study of vicinal Yb/Si(100)-(2x3) surface.- MAX-LAB Activity Report 2001, pp 92 - 93, Eds. J.N. Andersen, U. Johansson, R. Nyholm, and H. Ullman, Tryckning. KFS AB, Lund, Sweden, 2002.

2003

Papers

J. Hajek, N. Kumar, T. Salmi, D. Yu. Murzin, H. Karhu, J. Väyrynen, L. Cerveny and I. Paseka: Impact of catalyst reduction mode on selective hydrogenation of cinnamaldehyde over Ru-Sn sol-gel catalysts. – Industrial & Engineering Chemistry Research 42(2), 295 – 305 (2003).

P. Laukkanen, M. Kuzmin, R.E. Perälä, R.-L. Vaara and I.J. Väyrynen: Scanning tunneling microscopy study of GaAs(100) surface prepared by HCl-isopropanol treatment. – Applied Surface Science 206, 2 – 7 (2003).

M.P.J. Punkkinen, K. Kokko and I.J. Väyrynen: The Electronic Structure of Intermetallic Compound Gd₃Pd. - Journal of Alloys and Compounds 350, 5 – 8 (2003).

P. Mäki-Arvela, L.-P. Tiainen, M. Lindblad, K. Demirkan, N. Kumar, R. Sjöholm, T. Ollonqvist, J. Väyrynen, T. Salmi and D. Yu. Murzin: Liquid-phase hydrogenation of citral for production of citronellol: catalyst selection. – Applied Catalysis A: General 241, 271 - 288 (2003).

A. Kalantar Neyestanaki, P. Mäki-Arvela, H. Backman, H. Karhu, T. Salmi, J. Väyrynen, and D. Yu. Murzin: Kinetics and stereoselectivity of o-xylene hydrogenation over Pd/Al₂O₃. – Journal of Molecular Catalysis A: Chemical 193, 237 - 250 (2003).

M. Lindroos, P. Mäki-Arvela, N. Kumar, T. Salmi, D. Yu. Murzin, T. Ollonqvist and J. Väyrynen: Catalyst Deactivation in Selective Hydrogenation of β-Sitosterol to β-Sitostanol over Palladium. – Catalysis of Organic Reactions, Chemical Industries (Dekker) 89, 587 – 594 (2003).

R.-L. Vaara, M. Kuzmin, R.E. Perälä, P. Laukkanen and I.J. Väyrynen: Formation and thermal-desorption-controlled patterning of Yb-induced structures on vicinal Si(111) [112]-miscut surface. – *Surface Science*, 529, L229 - L233 (2003).

S. Kallip, P. Laukkanen, A. Jänes, V. Sammelselg, J. Väyrynen, P. Miidla and E. Lust: Investigation of the surface topography and double layer characteristics of variously pre-treated antimony single crystal electrodes. – *Surface Science* 532 – 535, 1121 – 1126 (2003).

M. Kuzmin, R.E. Perälä, P. Laukkanen, R.-L. Vaara, M.A. Mittsev and J. Väyrynen: Initial stages of Yb/Si(100) interface growth: 2x3 and 2x6 reconstructions. – *Applied Surface Science* 214, 196 – 207 (2003).

R.P. Socha and J. Väyrynen: The influence of fluoride anions on silicon carbide surface oxidation in aqueous solutions. – *Applied Surface Science* 212 – 213, 636 – 643 (2003).

M. Kuzmin, R.-L. Vaara, P. Laukkanen, R.E. Perälä and I.J. Väyrynen: Yb, Eu, and (Yb+Eu)-stabilized 3x1 and 3x2 reconstructions on Si(111). – *Surface Science* 538, 124 – 136 (2003).

A. Kalantar Neyestanaki, P. Mäki-Arvela, H. Backman, H. Karhu, T. Salmi, J. Väyrynen, and D.Yu. Murzin: Gas-phase hydrogenation of o-xylene over Pt/knitted silica-fiber catalysts. – *Industrial & Engineering Chemistry Research* 42, 3230 – 3236 (2003).

H. Karhu, A. Kalantar Neyestanaki, I.J. Väyrynen, T. Salmi and D. Yu. Murzin: XPS analysis of chlorine residuals in supported Pt and Pd catalysts with low metal loading. – *Applied Catalysis A: General* 247, 283 – 294 (2003)

A. Kalantar Neyestanaki, P. Mäki-Arvela, H. Backman, H. Karhu, T. Salmi, J. Väyrynen and D.Yu. Murzin: Gas-phase hydrogenation of o-xylene over Pt/alumina catalyst, activity and stereoselectivity. – *Journal of Catalysis* 218, 267 – 279 (2003).

R.-L. Vaara, M. Kuzmin, R.E. Perälä, P. Laukkanen and I.J. Väyrynen: Evolution of step and terrace structure on [112]- and [112]-miscut Si(111) surfaces upon formation of triple- and single domain Yb-induced 3x2 reconstruction. – *Surface Science* 539, 72 – 80 (2003).

J.-P. Mikkola, T. Salmi, A. Villela, H. Vainio, P. Mäki-Arvela, A. Kalantar, T. Ollonqvist, J. Väyrynen and R. Sjöholm: Hydrogenation of xylose to xylitol on sponge nickel catalyst – a study of the process and catalyst deactivation kinetics. – *Brazilian Journal of Chemical Engineering* 20(3), 263 – 271 (2003).

J. Hajek, N. Kumar, P. Mäki-Arvela, T. Salmi, D. Yu. Murzin, I. Paseka, T. Heikkilä, E. Laine, P. Laukkanen and J. Väyrynen: Ruthenium modified MCM-41 mesoporous molecular sieve and Y zeolite catalysts for selective hydrogenation of cinnamaldehyde. – *Applied Catalysis A: General* 251, 385 – 396 (2003).

R.-L. Vaara, M. Kuzmin, P. Laukkanen, R.E. Perälä, and I.J. Väyrynen: Two series of triple- and single-domain reconstructions induced by europium on vicinal Si(111) [112]-miscut surface. – *Applied Surface Science* **220**, 327 – 334 (2003).

Reports

R. Perälä, S. Mattila, P. Laukkanen, R.-L. Vaara, M. Kuzmin and J. Väyrynen: Study of vicinal Yb/Si(100) surface. - MAX-LAB Activity Report 2002, pp 80 -81, Eds. J.N. Andersen, U. Johansson, R. Nyholm and H. Ullman, Profiltryckeriet, Malmö, Sweden, 2003.

P. Laukkanen, R. Perälä, J. Sadowski, M. Kuzmin, R.-L. Vaara and I. J. Väyrynen: Electronic and structural analysis of Sb-induced GaAs(100)(2x4) surface. - MAX-LAB Activity Report 2002, pp 96 – 97, Eds. J.N. Andersen, U. Johansson, R. Nyholm and H. Ullman, Profiltryckeriet, Malmö, Sweden, 2003.

2004

Papers

M. Kuzmin, R.-L. Vaara, P. Laukkanen, R.E. Perälä and I.J. Väyrynen: Structural and statistical analysis of Yb/Si(111) and Eu/Si(111) reconstructions. – *Surface Science* **549**, 183 – 195 (2004).

M. Kuzmin, P. Laukkanen, R.E. Perälä, R.-L. Vaara and I.J. Väyrynen: Formation of ytterbium silicide nanowires on Si(001). – *Applied Surface Science* **222**, 394 – 398 (2004).

M. Kuzmin, R.E. Perälä, R.-L. Vaara, P. Laukkanen and I.J. Väyrynen: Formation of ytterbium silicide film on Si(001) by solid phase epitaxy. – *Journal of Crystal Growth* **262**, 231 – 239 (2004).

R.P. Socha, P. Nowak, K. Laajalehto and J. Väyrynen: Particle-electrode surface interaction during nickel electrodeposition from suspensions containing SiC and SiO₂ particles. – *Colloids and Surfaces A: Physicochemical Engineering Aspects* **235**, 45 – 55 (2004).

A. Bernas, N. Kumar, P. Mäki-Arvela, P. Laukkanen, J. Väyrynen, B. Holmbom, T. Salmi and D.Yu. Murzin: Influence of ruthenium precursor on catalytic activity of Ru/Al₂O₃ catalyst in selective isomerization of linoleic acid to cis-9, trans-11- and trans-10, cis-12-conjugated linoleic acid. – *Applied Catalysis A: General* **267**, 121 – 133 (2004).

N. Kumar, P. Mäki-Arvela, J. Hajek, T. Salmi, D. Yu. Murzin, T. Heikkilä, E. Laine, P. Laukkanen and J. Väyrynen: Physico-chemical and catalytic properties of Ru-MCM-41 mesoporous molecular sieve catalyst: Influence of Ru modification methods. – *Microporous and Mesoporous Materials* **69**, 173 – 179 (2004).

P. Laukkanen, R.E. Perälä, R.-L. Vaara, I.J. Väyrynen, M. Kuzmin and J. Sadowski: Electronic and structural analysis of Sb-induced GaAs(100) (2x4) and (2x8) surfaces. – Physical Review B 69, 205323 (2004).

M.P.J. Punkkinen, L. Vitos, K. Kokko, K. Laaksonen and I.J. Väyrynen: Electronic and magnetic properties of bulk and (100) and (111) surfaces of MnPt₃: An ab initio study. – Physical Review B 70, 024411 (2004).

Reports

M. Kuzmin, P. Laukkanen, R. Perälä, R.-L. Vaara and I. J. Väyrynen: Si 2p core-level photoemission study of Eu/Si(111) reconstructions - MAX-LAB Activity Report 2003, pp 96 – 97, Eds. J.N. Andersen, U. Johansson, R. Nyholm and H. Ullman, Sweden, 2004.

R. E. Perälä, M. Kuzmin, P. Laukkanen, R.-L. Vaara and I. J. Väyrynen: Study of Eu-induced 2x3/3x2 reconstructions on flat and vicinal Si(100) surface. - MAX-LAB Activity Report 2003, pp 100 – 101, Eds. J.N. Andersen, U. Johansson, R. Nyholm and H. Ullman, Sweden, 2004.

P. Laukkanen, R. E. Perälä, R.-L. Vaara, I. J. Väyrynen J. Sadowski, M. Kuzmin: Photoemission study of InAs(100)(2x4) reconstruction. - MAX-LAB Activity Report 2003, pp 118 – 119, Eds. J.N. Andersen, U. Johansson, R. Nyholm and H. Ullman, Sweden, 2004.

2005

Papers

I. Blaszczyk-Lezak, A.M. Wrobel, M.P.M. Kivitörmä and I.J. Väyrynen: Silicon carbonitride films produced by remote hydrogen microwave plasma CVD using a (dimethylamino) dimethylsilane precursor. – Chemical Vapor Deposition 11, 44 – 52 (2005).

M.Kuzmin, P. Laukkanen, R.E. Perälä, R.-L. Vaara, I.J. Väyrynen: Atomic structure of the Eu/Si(111) 3x2, 5x1, and 7x1 surfaces studied by photoelectron spectroscopy. – Physical Review B 71, 155334 (2005) .

M. Kuzmin, P. Laukkanen, R.E. Perälä and I.J. Väyrynen: Observation of double- to single-domain transition on the Eu/Si(100) surface by LEED and STM. – Surface Science 584, 1 – 7 (2005).

R.E. Perälä, M. Kuzmin, P. Laukkanen, R.-L. Vaara and I.J. Väyrynen: Eu- and Yb-induced reconstructions on a vicinal Si(100) surface. – Surface Science 584, 8 – 16 (2005).

P. Laukkanen, M. Kuzmin, R. E. Perälä, M. Ahola, S. Mattila, I. J. Väyrynen, J. Sadowski, J. Konttinen, T. Jouhti, C. S. Peng, M. Saarinen and M. Pessa: Electronic and structural properties of InAs (100)(2x4) and GaAs (100)(2x4) surfaces studied by

core-level photoemission and scanning tunneling microscopy: - Physical Review B72, 045321 (2005).

M.Kuzmin, R.E. Perälä, P. Laukkanen, I.J. Väyrynen: Atomic geometry and electronic structure of the Si(100)2x3-Eu surface phase. – Physical Review B72, 085343 (2005) .

J. Kuusisto, J.-P. Mikkola, P. Perez Casal, H. Karhu, J. Väyrynen, T. Salmi: Kinetics of the catalytic hydrogenation of D-fructose over a CuO-ZnO catalyst. – Chemical Engineering Journal 115, 93 – 102 (2005).

P. Laukkanen, M. Ahola, M. Kuzmin, R.E. Perälä and I.J. Väyrynen and J. Sadowski: Bi-induced (2x6), (2x8), and (2x4) reconstructions on the InAs(100) surface. – Surface Science Letters 598, L361 – L367 (2005).

Reports

M. Kuzmin, R.E. Perälä, P. Laukkanen and I.J. Väyrynen: Electronic and structural properties of GaAs(100)(2x4) and InAs(100)(2x4) surfaces. In: Andersen, J.N., Johansson, U., Nyholm, R. & Ullman, H. (eds): MAX-lab Activity report 2004. Lund: National Laboratory, pp. 86-87 (2005).

P. Laukkanen, M. Kuzmin, R.E. Perälä, M. Ahola, I.J. Väyrynen and J. Sadowski: Electronic and structural properties of GaAs(100)(2x4) and InAs(100)(2x4) surfaces. In: Andersen, J.N., Johansson, U., Nyholm, R. & Ullman, H. (eds): MAX-lab Activity report 2004. Lund: National Laboratory, pp. 106-107 (2005).