PUBLICATIONS J.W.M. Frenken

Note: the Interface Physics Group at Leiden University, headed by Joost Frenken, has more publications, patents and patent applications than you will find here; these are not incorporated in this list as Frenken runs a strict policy of avoiding ‘automatic’ co-author- and ownerships.

Books and Book Chapters

13 Operando studies in heterogeneous catalysis

12 In-Situ Materials Characterization Across Spatial and Temporal Scales

11 Scanning Tunneling Microscopy at elevated pressure: operando observations of model catalysts
   J.W.M. Frenken

10 The physics of atomic-scale friction: basic considerations and open questions
   S.Yu. Krylov and J.W.M. Frenken

9 Graphene Formation on Metal Surfaces Investigated by In-situ STM
   G. Dong, D.W. van Baarle and J.W.M. Frenken

8 Microscale friction reduction by normal force modulation in MEMS
   W.M. van Spengen, G.H.C.J. Wijts, V. Turq and J.W.M. Frenken

7 Experimental observations of superlubricity and thermolubricity
   M. Dienwiebel and J.W.M. Frenken

6 Diffusion of vacancies in metal surfaces: theory and experiment
   R. van Gastel, J.W.M. Frenken, B.S. Swartzentruber, E. Somfai and W. van Saarloos

5 Microscopen met nanoschaalresolutie

4 Scanning tunneling microscopy
   J.W.M. Frenken

3 Surface Melting: an Experimental Overview
   J.W.M. Frenken and H.M. van Pinxteren
2 Quasielastic He-Atom Scattering Studies of Adatom Diffusion on Surfaces
J.W.M. Frenken and B.J. Hinch,

1 Structure, Dynamics, and Melting of Metal Surfaces
J.W.M. Frenken

Review articles
15 The physics of atomic-scale friction: basic considerations and open questions
S.Yu. Krylov and J.W.M. Frenken
Review paper (invited), accepted for publication in Physica Status Solidi B.

14 Microscopy: when mica and water meet
J.W.M. Frenken and T.H. Oosterkamp,

13 Video-rate scanning probe control challenges: setting the stage for a microscopy revolution
M.J. Rost, G.J.C. van Baarle, A.J. Katan, W.M. van Spengen, P. Schakel, W.A. van Loo, T.H. Oosterkamp and J.W.M. Frenken

12 The Reactor-STM, a real-space, in-situ probe for nano-catalysis
J.W.M. Frenken and B.L.M. Hendriksen,

11 Bringing friction to a halt
J.W.M. Frenken

10 Looking at heterogeneous catalysis at atmospheric pressure using tunnel vision
B.L.M. Hendriksen, S.C. Bobaru and J.W.M. Frenken

9 Bistability and oscillations in CO oxidation studied with scanning tunnelling microscopy inside a reactor
B.L.M. Hendriksen, S.C. Bobaru and J.W.M. Frenken

8 Pushing the limits of SPM
J.W.M. Frenken, T.H. Oosterkamp, B.L.M. Hendriksen and M.J. Rost

7 Slippery Nanoworld
E. Gnecco, A. Socoliuc, E. Meyer, A. Baratoff, R. Bennewitz, M. Dienwiebel and J.W.M. Frenken

6 Diffusion on and in surfaces: the atomic slide puzzle
J.W.M. Frenken, R. van Gastel, S.B. van Albada, E. Somfai and W. van Saarloos
Collective Diffusion on Surfaces: Correlation Effects and Adatom Interactions , Eds. M.C. Tringides and Z. Chvoj,

5 Surface energetics and dynamics measured from STM movies

4 Surface Melting: Dry, Slippery, Wet and Faceted Surfaces
J.W.M. Frenken and H.M. van Pinxteren
3 New Views on Surface Melting Obtained with STM and Ion Scattering
J.W.M. Frenken, H.M. van Pinxteren and L. Kuipers

2 Experimental Investigations of Surface Melting
J.W.M. Frenken, J.P. Toennies, Ch. Wöll, B. Pluis, A.W. Denier van der Gon and J.F. van der Veen

1 Ion Beam Crystallography of Solid and Molten Surfaces
J.F. van der Veen and J.W.M. Frenken

**Patent applications**
3 Tuneable graphene growth from a solid solution by substrate thickness control
R. van Rijn and G. Dong
Patent Application, November, 2011. (even though Frenken is not one of the official authors, this patent resulted from research performed fully under his supervision within the IP-group, which is why it is listed here)

2 Using deliberately misoriented metal surfaces as a template for the growth of high-quality graphene, boron nitride and other atom layers or thin films
J.W.M. Frenken

1 Piëzo-actuator voor een bewegingselement en houder voor een dergelijke actuator
W.A. van Loo and J.W.M. Frenken

**Papers currently under review**
4 Why do we “feel” atoms in nano-scale friction?

3 Capillary condensation in atomic-scale friction
K.B. Jinesh and J.W.M. Frenken

2 Formation, diffusion, and annihilation of a surface vacancy on Cu(100). I. Scanning tunneling microscopy

1 Formation, diffusion, and annihilation of a surface vacancy on Cu(100). II. Theory of vacancy-assisted diffusion
T.H. Beuman, K. Schoots and J.W.M. Frenken

**Published papers** (in refereed journals and refereed conference proceedings)
145 Superlubric to stick-slip sliding of incommensurate graphene flakes on graphite
M.M. van Wijk, A. Fasolino, M. Dienwiebel and J.W.M. Frenken

144 Kinetics of graphene formation on Rh(111) investigated by in-situ Scanning Tunneling Microscopy
G. Dong, D.W. van Baarle, M.J. Rost and J.W.M. Frenken

143 The problem of critical damping in nanofriction
S.Yu. Krylov, J.W.M. Frenken
142 Graphene formation on metal surfaces investigated by in-situ scanning tunneling microscopy
G.C. Dong, D.W. van Baarle, M.J. Rost, J.W.M. Frenken

141 The Active Phase of Palladium during Methane Oxidation
A. Hellman, A. Resta, M.N. Martin, J. Gustafson, A. Trinchero, P.A. Carlsson, O. Balmes, R. Felici, R.
van Rijn, J.W.M. Frenken, J.N. Andersen, E. Lundgren, H. Gronbeck

140 Reversible formation of a PdCx phase in Pd nanoparticles upon CO and O-2 exposure
O. Balmes, A. Resta, D. Wermeille, R. Felici, M.E. Messing, K. Deppert, Z. Liu, M.E. Grass, H. Bluhm,
R. van Rijn, J.W.M. Frenken, R. Westerström, S. Blomberg, J. Gustafson, J.N. Andersen, E. Lundgren

139 A general model of metal underpotential deposition in the presence of thiol-based additives
based on an in situ STM study
Y. Yanson, J.W.M. Frenken and M.J. Rost

138 Surface structure and reactivity of Pd(100) during CO oxidation near ambient pressures
R. van Rijn, O. Balmes, A. Resta, D. Wermeille, R. Westerström, J. Gustafson, R. Felici, E. Lundgren,
J.W.M. Frenken

137 A new role for steps in catalysis
B.L.M. Hendriksen, M.D. Ackermann, S.C. Bobaru, I. Popa, S. Ferrer and J.W.M. Frenken

136 Reply to “Comment on “Catalytic Activity of the Rh Surface Oxide: CO Oxidation over Rh(111)
der under Realistic Conditions””
J. Gustafson, R. Westerström, O. Balmes, A. Resta, R. van Rijn, X. Torrelles, C.T. Herbschleb, J.W.M.
Frenken, E. Lundgren

135 Response to “Comment on ‘MEMS-based high speed scanning probe microscopy’”
W.M. van Spengen

134 The description of friction of silicon MEMS with surface roughness: virtues and limitations of a
stochastic Prandtl-Tomlinson model and the simulation of vibration-induced friction reduction
W.M. van Spengen, V. Turq and J.W.M. Frenken

133 Microscale friction reduction by normal force modulation in MEMS
W.M. van Spengen, G.H.C.J. Wijts, V. Turq and J.W.M. Frenken

132 Reply to “Comment on ‘Catalytic activity of the Rh surface oxide: CO oxidation over Rh(111)
der under realistic conditions’”
J. Gustafson, R. Westerström, O. Balmes, A. Resta, R. van Rijn, X. Torrelles, C.T. Herbschleb, J.W.M.
Frenken and E. Lundgren

131 Comment on “CO Oxidation on Pt Group Metals from Ultrahigh Vacuum to Near Atmospheric
Pressures. 2. Palladium and Platinum”
R. van Rijn, O. Balmes, R. Felici, J. Gustafson, D. Wermeille, R. Westerström, E. Lundgren and J.W.M.
Frenken

130 MEMS-Based Fast Scanning Probe Microscopes
Frenken and W.M. van Spengen
129 **MEMS-based high speed scanning probe microscopy**  

128 **High-Pressure STM Study of NO reduction by CO on Pt(100)**  
C.T. Herbschleb, S.C. Bobaru and J.W.M. Frenken  

127 **How Boron Nitride Forms a Regular Nanomesh on Rh(111)**  
G. Dong, E.B. Fourré, F.C. Tabak and J.W.M. Frenken  

126 **Catalytic Activity of the Rh Surface Oxide: CO Oxidation over Rh(111) under Realistic Conditions**  
J. Gustafson, R. Westerström, O. Balmes, A. Resta, R. van Rijn, X. Torrelles, C.T. Herbschleb, J.W.M. Frenken and E. Lundgren  

125 **Ultrahigh vacuum/high-pressure flow reactor for surface x-ray diffraction and grazing incidence small angle x-ray scattering studies close to conditions for industrial catalysis**  

124 **Atomic-scale friction experiments reconsidered in the light of rapid contact dynamics**  
S.Yu. Krylov and J.W.M. Frenken  

123 **Thermolubricity in atomic-scale friction**  

122 **The crucial role of temperature in atomic scale friction**  
S.Yu. Krylov and J.W.M. Frenken  

121 **Experimental evidence for ice formation at room temperature**  
K.B. Jinesh and J.W.M. Frenken  

120 **Structure and reactivity of a model catalyst alloy under realistic conditions**  

119 **Torque and twist against superlubricity**  
A.E. Filippov, M. Dienwiebel, J.W.M. Frenken, J. Klafter and M. Urbakh  

118 **Oxidation of Pd(553): From ultrahigh vacuum to atmospheric pressure**  

117 **Thermal contact delocalization in atomic scale friction: a multitude of friction regimes**  
S.Yu. Krylov and J.W.M. Frenken  

116 **Evidence for contact delocalization in atomic scale friction**  
D. Abel, S.Yu. Krylov and J.W.M. Frenken  

115 **The Leiden MEMS Tribometer: Real Time Dynamic Friction Loop Measurements With an On-Chip Tribometer**  
W.M. van Spengen and J.W.M. Frenken
114 A 'nano-battering ram' for measuring surface forces: obtaining force–distance curves and sidewall stiction data with a MEMS device
W.M. van Spengen, E. Bakker and J.W.M. Frenken

113 The return of the kink
G.S. Verhoeven and J.W.M. Frenken

112 Stick-slip motion in spite of a slippery contact: Do we get what we see in atomic friction?
S.Yu. Krylov, J.A. Dijksman, W.A. van Loo, J.W.M. Frenken

111 Capillary condensation in atomic-scale friction: how water acts like glue
K.B. Jinesh and J.W.M. Frenken

110 Structure and Reactivity of Surface Oxides on Pt(110) during Catalytic CO Oxidation
M.D. Ackermann, T.M. Pedersen, B.L.M. Hendriksen, O. Robach, S. Bobaru, I. Popa, C. Quiros, H. Kim, B. Hammer, S. Ferrer and J.W.M. Frenken

109 Scanning probe microscopes go video rate and beyond

108 Thermally induced suppression of friction at the atomic scale

107 Design and performance of a high-resolution frictional force microscope with quantitative three-dimensional force sensitivity

106 Model experiments of superlubricity of graphite
M. Dienwiebel, N. Pradeep, G.S. Verhoeven, J.W.M. Frenken, and H.W. Zandbergen

105 Model calculations of superlubricity of graphite
G.S. Verhoeven, M. Dienwiebel and J.W.M. Frenken

104 Diffusion and incorporation of a surfactant: In on Cu(001)
R. van Gastel, M.F. Roşu, M.J. Rost, L. Niesen and J.W.M. Frenken

103 Oscillatory CO oxidation on Pd(100) studied with in situ scanning tunneling microscopy
B.L.M. Hendriksen, S.C. Bobaru and J.W.M. Frenken

102 Superlubricity of graphite
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101 The electron conduction of photosynthetic protein complexes embedded in a membrane
A. Stamouli, J.W.M. Frenken, T.H. Oosterkamp, R.J. Cogdell and T.J. Aartsma

100 Thermally activated domain boundary formation on a missing row reconstructed surface: Au(110)
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Grains, growth, and grooving
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The ring structure and organization of light harvesting 2 complexes in a reconstituted lipid bilayer, resolved by atomic force microscopy
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Towards submolecular resolution of Pisum sativum lectin by Atomic Force Microscopy with chemically functionalized tips

Resolving the structure and organization of photosynthetic protein complexes
A. Stamouli, D.C.G. Klein, T.H. Oosterkamp, J.W.M. Frenken, R. Cogdell, and T.J. Aartsma

Towards submolecular resolution on plant lectin with chemically functionalized single-walled carbon nanotube AFM tips
D.C.G. Klein, H. Jensenius, J. Kijne, K. Sliedregt Bol, G. van der Marel, J.W.M. Frenken and T.H. Oosterkamp

CO-oxidation on Pt(110): Scanning Tunneling Microscopy inside a flow-reactor
B.L.M. Hendriksen and J.W.M. Frenken

Vacancy diffusion in the Cu(001) surface II: Random walk theory
E. Somfai, R. van Gastel, S.B. van Albada, W. van Saarloos and J.W.M. Frenken

Vacancy diffusion in the Cu(001) surface I: An STM study
R. van Gastel, E. Somfai, S.B. van Albada, W. van Saarloos and J.W.M. Frenken

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A. Stamouli, S.T. Kafi, A.J. Hoff, J.W.M. Frenken, T.H. Oosterkamp, and T.J. Aartsma,

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M.J. Rost, S.B. van Albada and J.W.M. Frenken

Shape and decay of two- and three-dimensional islands on Au(110)
M.J. Rost, S.B. van Albada and J.W.M. Frenken

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Asymmetric and symmetric Wulff constructions of island shapes on a missing-row reconstructed surface
S.B. van Albada, M.J. Rost and J.W.M. Frenken

Diffusion in a surface: The atomic slide puzzle
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85  The effect of stoichiometry on the stability of steps on TiO\textsubscript{2} (110)
M.J.J. Jak, A. van Kreuningen, J. Verhoeven and J.W.M. Frenken

84  The influence of substrate defects on the growth rate of palladium nanoparticles on a TiO\textsubscript{2}(110) surface
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83  Automated detection of particles, clusters and islands in Scanning Probe Microscopy images
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82  Comment on Real space investigation of the roughening and deconstruction transition of Au(110)
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81  How asymmetric islands become symmetric
M.J. Rost, S.B. van Albada and J.W.M. Frenken

80  Nothing moves a surface: vacancy mediated surface diffusion
R. van Gastel, E. Somfai, S.B. van Albada, W. van Saarloos and J.W.M. Frenken

79  Towards the ideal nano-friction experiment
J.W.M. Frenken, M. Dienwiebel, J.A. Heimberg, T. Zijlstra, E. van der Drift, D.J. Spaanderman and E. de Kuiper

78  A giant atomic slide puzzle
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77  Fabrication of a Novel Scanning Probe Device for Quantitative Nanotribology

76  Scanning tunneling microscopy study of the growth of small palladium particles on TiO\textsubscript{2}(110)
M.J.J. Jak, C. Konstapel, A. van Kreuningen, J. Verhoeven and J.W.M. Frenken

75  Anomalous shape and decay of islands on Au(110)
M.J. Rost, R. van Gastel and J.W.M. Frenken

74  Monte Carlo simulation on the surface roughening of vicinal surfaces
M.S. Hoogeman and J.W.M. Frenken

73  An experimental verification of the theory of surface roughening from a quantitative STM study
M.S. Hoogeman, M.A.J. Klik, D.C. Schlösser, L. Kuijpers and J.W.M. Frenken

72  Direct observation and analysis of kink dynamics
M.S. Hoogeman, L. Kuijpers, D.C. Schlösser and J.W.M. Frenken

71  The step distance dependence of the kink creation energy determined on vicinal Ag surfaces
M.F. Chang, M.S. Hoogeman, M.A.J. Klik and J.W.M. Frenken
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70  Are vicinal metal surfaces stable?
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69 On the smoothing of rough surfaces  
M.S. Hoogeman, M.A.J. Klik, R. van Gastel and J.W.M. Frenken  

68 Real-space measurement of surface roughening  
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67 The ‘Reactor STM’: A scanning tunneling microscope for investigation of catalytic surfaces at semi-industrial reaction conditions  
P.B. Rasmussen, B.L.M. Hendriksen, H. Zeijlemaker, H.G. Ficke and J.W.M. Frenken  

66 Design and performance of a programmable-temperature scanning tunneling microscope  

65 Spontaneous breaking of nanowires between a STM tip and the Pb(110) surface  
Z. Gai, X. Li, B. Gao, R.G. Zhao, W.S. Yang and J.W.M. Frenken  

64 New scanning probes for nanotribology  
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63 Oxygen dissociation on Ag(110): a ruin game  
J.B. Sanders, D.A. Butler, A. Raukema, A.W. Kleyn and J.W.M. Frenken  
*Surface Sci.* **375** (1997) 141.

62 A model system for scandate cathodes  
P.M. Zagwijn, J.W.M. Frenken, U. van Slooten and P.A. Duine  

61 Kink diffusion: from atomistic mechanism to mesoscopic consequences  
J.W.M. Frenken, M.S. Hoogeman and L. Kuipers,  

60 Surface-melting induced faceting of aluminium  
A.M. Molenbroek and J.W.M. Frenken  

59 Difference in surface melting between indium (110) and (011)  
A.M. Molenbroek, G. ter Horst and J.W.M. Frenken  

58 Surface Energetics and Thermal Roughening of Ag(115) Studied with STM Movies  
M.S. Hoogeman, D.C. Schlößer, J.B. Sanders, L. Kuipers and J.W.M. Frenken  

57 Growth Mode and Interface Structure of Ag on the HF-Treated Si(111):H Surface  
A. Nishiyama, G. ter Horst, P. Zagwijn, G. van den Hoven, J.W.M. Frenken, F. Garten, B. Schlatmann and J. Vrijmoeth  

56 Step and Kink Dynamics on Au(110) and Pb(111) Studied with a High-Speed STM  
L. Kuipers, M.S. Hoogeman, J.W.M. Frenken and H. van Beijeren  

55 Jump-to-Contact and Neck Formation between Pb Surfaces and an STM Tip  
L. Kuipers, M.S. Hoogeman and J.W.M. Frenken
54 Design and Performance of a High-Temperature High-Speed STM

53 Structure Analysis of the HF-treated Si(111):H Surface with Medium-Energy Ion Scattering
A. Nishiyama, G. ter Horst, M. Lohmeier, A.M. Molenbroek and J.W.M. Frenken

52 Anharmonicity but Absence of Surface Melting on Al(001)
A.M. Molenbroek and J.W.M. Frenken

51 Two-Dimensional Position Sensitive Detection for Medium-Energy Ion Scattering
P.M. Zagwijn, A.M. Molenbroek, J. Vrijmoeth, G.J. Ruwiel, R.M. Ulterlinden, J. ter Horst, J. ter Beek
and J.W.M. Frenken

50 Surface Diffusion: an STM View
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49 Temperature dependence of surface-melting induced faceting of surfaces vicinal to Pb(111)
H.M. van Pinxteren, B. Pluis and J.W.M. Frenken

48 Thermal Roughening Investigated by Scanning Tunneling Microscopy
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U. van Slooten, W.R. Koppers, A. Bot, H.M. van Pinxteren, A.M.C. Moutinho, J.W.M. Frenken and A.W.
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45 Jump-to-Contact, Neck Formation and Surface Melting in the Scanning Tunneling Microscope
L. Kuipers and J.W.M. Frenken

44 The Initial Stages of the Oxidation of Al(111) II
E.R. Wouters, D.J. O’Connor, J.F. van der Veen, P.M. Zagwijn, J. Vrijmoeth, W. Slijkerman and J.W.M.
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43 The Initial Stages of the Oxidation of Al(111) I
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41 Structure Determination of the NiSi2(111) Surface with Medium Energy Ion Backscattering from
Individual Monolayers
J. Vrijmoeth, P.M. Zagwijn, E. Vlieg and J.W.M. Frenken

40 Formation of Epitaxial β-FeSi2 Films on Si(001) as Studied by Medium-Energy Ion Scattering
K. Konuma, J. Vrijmoeth, P.M. Zagwijn, J.W.M. Frenken, E. Vlieg and J.F. van der Veen
39 **Observation of Surface-Melting Induced Faceting**
H.M. van Pinxteren and J.W.M. Frenken

38 **Incomplete Melting of Pb(001) and Vicinal Surfaces**
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37 **On the Displacement Statistics of an Individual Step Edge in a Vicinal Surface**
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36 **The CoSi$_2$/Si(111) Interface Revisited: Determination of Interfacial Metal Coordination Number**
J. Vrijmoeth, S. Zaima, E. Vlieg and J.W.M. Frenken

35 **Sulfur Adatom Diffusion on the Cu(111) Surface**
B.J. Hinch, J.W.M. Frenken, G. Zhang and J.P. Toennies

34 **Anisotropy in Surface Melting of Pb(110)**
A.W. Denier van der Gon, H.M. van Pinxteren, J.W.M. Frenken and J.F. van der Veen
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A.W. Denier van der Gon, J.M. Gay, J.W.M. Frenken and J.F. van der Veen

31 **Combined (1x2) → (1x1) Transition and Atomic Roughening of Ge(001) Studied with Surface X-ray Diffraction**
A.D. Johnson, C. Norris, J.W.M. Frenken, H.S. Derbyshire, J.E. MacDonald, R.G. van Silfhout and J.F. van der Veen

30 **Order-Disorder Transitions at Surfaces**
J.F. van der Veen and J.W.M. Frenken

29 **Monolayer Resolution in Medium-Energy Ion-Scattering Experiments on the NiSi$_2$(111) Surface**
J. Vrijmoeth, P.M. Zagwijn, J.W.M. Frenken and J.F. van der Veen

28 **Structure Determination of the NiSi$_2$(111) Surface using Medium Energy Ion Scattering with Monolayer Resolution**
J. Vrijmoeth, P.M. Zagwijn, J.W.M. Frenken and J.F. van der Veen

27 **Thermal Roughening Studied by Scanning Tunneling Microscopy**
J.W.M. Frenken, R.J. Hamers and J.E. Demuth

26 **Anisotropic Diffusion at a Melting Surface Studied with He Atom Scattering**
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21 Surface Melting of Pb(110): a Compilation of Experimental Results
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20 He Scattering Study of Diffusion at a Melting Surface
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19 Self-Diffusion at a Melting Surface Observed by He Scattering
J.W.M. Frenken, J.P. Toennies and Ch. Wöll

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