

# Seventh International Conference on non-contact Atomic Force Microscopy

12–15 September, 2004

Seattle, Washington USA

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### Registration and Conference Management

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# Sponsoring Organizations

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We gratefully acknowledge financial support from the following companies and organizations:

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**PNNL/UW Joint Institute for Nanoscience**

## Conference Activities

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### **Pre-Conference Workshop: ncAFM for New Investigators**

Sunday, 12 September, 1:00–5:00 p.m.  
A110 Physics / Astronomy Building

### **Welcome Reception**

Sunday, 12 September, 6:00–8:00 p.m.  
Physics / Astronomy Auditorium Lobby

### **Technical Sessions**

Monday, 13 September, 9:00 a.m.–5:00 p.m.  
Tuesday, 14 September, 9:00 a.m.–5:20 p.m.  
Wednesday, 15 September, 9:00 a.m.–5:00 p.m.  
A102 Physics / Astronomy Auditorium

### **Poster Sessions**

Monday, 13 September, 7:30–9:30 p.m.  
Tuesday, 14 September, 7:30–9:30 p.m.  
Physics / Astronomy Auditorium Lobby

### **Conference Banquet**

Wednesday, 14 September  
6:30 p.m. No-Host Reception  
7:00 p.m. Dinner  
Faculty Club, University of Washington Campus

# Preface

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This series of International Conferences on Noncontact Atomic Force Microscopy is the primary international venue for sharing advances in this rapidly developing technique that enables atomic resolution investigation of both insulating and conducting surfaces in vacuum, as well as topographical measurements with minimal forces in air and fluids. The technique of vibrating a micron size cantilever with a nanometer scale tip near a surface to be investigated for mechanical, electrical, or magnetic properties was introduced for imaging in air at IBM Yorktown Heights by Martin, Williams, and Wickramasinghe (1987). Greatly enhanced sensitivity was obtained at IBM Almaden by Albrecht, Grutter, Horne, and Rugar (1991) by mounting the cantilever and sample in vacuum and detecting the change in resonant frequency of the vibrating cantilever. Atomic resolution of the reconstructed silicon (111) surface was first obtained by extending measurements to ultrahigh vacuum a decade ago at Park Scientific Instruments in Sunnyvale, CA (now part of Veeco) by Giessibl (1995) and at JEOL, Inc. in Japan by Kitamura and Iwatsuki (1995). Professor Seizo Morita will comment briefly on this past decade of atomic resolution in his introductory remarks.

These conferences were started in Japan by Professor Morita and then continued in Switzerland, Germany, Japan, Canada, and Ireland, as listed on the inside front cover. We welcome all participants to this first conference in the USA. We especially thank Franz Giessibl, Michael Reichling, and Seizo Morita for encouraging us to invite the conference to Seattle. The steering committee ably set the general direction for this meeting and the program committee worked very hard with the difficult tasks of choosing from the many nominees for invited speakers and of deciding which presentations would be given as talks and which as posters. We thank the invited speakers for the workshop and conference, as well as all who have strived to make the best contributed presentations possible. We thank Udo Schwarz for being guest editor of the special issue of the journal *Nanotechnology* which will contain some of the contributions from this conference. And most important of all has been the very efficient help from Jan Kvamme and the rest of the Engineering Professional Programs staff at the University of Washington.

We are grateful to Dr. Hollis Wickman for arranging the National Science Foundation support for travel for USA investigators to the previous conference in Ireland through NSF DMR 0305023 and support for lower registration fees for students and workshop attendees and financial travel assistance to some students, postdoctorals, and new investigators through NSF DMR-0355441. Our other financial sponsors are also acknowledged on an earlier page.

Welcome to Seattle and may you have a glimpse of our beautiful surroundings while you are here.

Sam Fain, Chair of the Program and Local Committees for ncAFM04

Albrecht, T. (1991), P. Grutter, D. Horne, and D. Rugar, *J. Appl. Phys.* **69**, 668.

Giessibl, F. J. (1995), *Science* **267**, 68.

Kitamura, S. (1995) and M. Iwatsuki, *Jpn. J. Appl. Phys.* **34**, L145.

Martin, Y. (1987), C. C. Williams, and H. K. Wickramasinghe, *J. Appl. Phys.* **61**, 4723.

# PROGRAM

## Sunday, September 12, 2004

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### 13:00–17:00 **Pre-Conference Workshop: ncAFM for New Investigators**

A110 Physics / Astronomy

### 17:00–19:00 **Welcome Reception**

Physics / Astronomy Auditorium Lobby

## Monday, September 13, 2004

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### 9:00–9:20 **Opening Remarks**

Welcome

S.C. Fain, Conference Chair, University of Washington

Celebrating a decade of atomic resolution ncAFM

S. Morita, Osaka University

### 9:20–10:20 **Atomic Resolution**

**Chair: S. Morita**

#### 9:20 **Investigating Atomic Details of the CaF<sub>2</sub>(111) Surface with a qPlus sensor** 19

F. Giessibl, M. Reichling\*

Universität Augsburg, \*Universitaet Osnabrück, Germany

#### 9:40 **Contrast Formation on Surfaces Composed of Hexagonally Arranged Carbon Atoms** 20

M. Ashino, A. Schwarz, H. Hoelscher\*, U.D. Schwarz\*\*, W. Allers\*\*\*, R. Wiesendanger  
University of Hamburg, Germany

\*University of Muenster, Germany

\*\*Yale University, USA

\*\*\*Infineon Technologies, Munich, Germany

#### 10:00 **Sub-Å resolution by force microscopy** 21

S. Hembacher, F.J. Giessibl, J. Mannhart

University of Augsburg, Germany

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**Chair: U.D. Schwarz**

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M. Ashino, T. Maltezopoulos, T. Behnke, A. Schwarz, R. Wiesendanger

University of Hamburg, Germany

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I. Schmid, P. Kappenberger\*, H.J. Hug\*

Institute of Physics, University of Basel, Switzerland

\*Swiss Federal Laboratories for Materials Testing and Research, Switzerland

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| 12:00       | <b>Lunch on your own</b>   |                            |
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|             | <u>S. Kawai</u> , S. Kitamura*, D. Kobayashi**, H. Kawakatsu<br>University of Tokyo, Japan<br>*JEOL Ltd., Japan<br>**Japan Science and Technology Corporation, Japan   |                            |
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|             | <u>R. Szoszkiewicz</u> , B. Bhushan*, B.D. Huey**, A.J. Kulik***, G. Gremaud***, E. Riedo<br>Georgia Institute of Technology, USA<br>*Ohio State University, USA<br>**National Institute of Standards and Technology, USA<br>***Swiss Federal Institute of Technology, Switzerland |                            |
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## Tuesday, September 14, 2004

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N. Oyabu, Y. Sugimoto, O. Custance\*, M. Abe, S. Morita  
Osaka University, Japan  
\*Handai Frontier Research Center, Japan

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N. Oyabu, O. Custance\*, M. Abe, S. Morita  
Osaka University, Japan  
\*Handai Frontier Research Center, Japan

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I. Stich, P. Dieska, R. Perez\*  
Slovak University of Technology, Slovak Republic  
\*Universidad Autonoma de Madrid, Spain

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O. Pfeiffer, S. Maier, A. Wetzel, E. Meyer, C. Gerber  
University of Basel, Switzerland  
\*McGill University, Montreal, Canada

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S.A. Burke, J.M. Mativetsky, R. Hoffmann\*, P. Grutter  
McGill University, Canada  
\*McGill University/Uni-Karlsruhe

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A.S. Foster, A.Y. Gal\*, A.L. Shluger\*, R.M. Nieminen  
Helsinki University of Technology, Finland  
\*University College London, UK

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University of Technology Dresden, Germany

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A. Sasahara, C.L. Pang, H. Uetsuka, H. Onishi  
Kanagawa Academy of Science and Technology, Japan

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| 19:30–21:30 | Tuesday Evening Poster Session (listing on pages 13–15)  |                          |

## Wednesday, September 15, 2004

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## Wednesday, September 15, 2004

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|             |   |                             |
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