

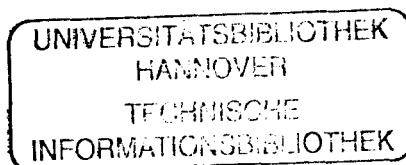
Forschungszentrum Jülich GmbH  
Institut für Festkörperforschung

Lecture manuscripts of the  
34<sup>th</sup> Spring School of the Department of Solid State Research

**Stefan Blügel, Martina Luysberg, Knut Urban, Rainer Waser (Eds.)**

# **Fundamentals of Nanoelectronics**

This spring school was organized on March 10 - 21, 2003  
in the Forschungszentrum Jülich GmbH  
by the Institut für Festkörperforschung  
in collaboration with  
universities, research institutes and the industry.



Schriften des Forschungszentrums Jülich  
Reihe Materie und Material / Matter and Materials

Volume 14

ISSN 1433-5506

ISBN 3-89336-319-X

# Contents

## Foreword

## A Basics

- A1      Basics of Quantum Mechanics and Solid State Physics  
*H. Lütth*
- A2      Ballistic Transport through Nanostructures  
*von Delft*
- A3      Theory of Tunneling Spectroscopy  
*D. Pfannkuche*
- A4      Spin Dependent Transport  
*S. Blügel*
- A5      Quantum Computing and Communication  
*Th. Schäpers*

## B Analysis

- B1      Scanning Tunneling Microscopy and Spectroscopy  
*P. Ebert*
- B2      Principle of High-Resolution Atomic Force Microscopy  
*F. Gießel*
- B3      High resolution transmission electron microscopy  
*A. Thust*
- B4      Spatially Resolved Electron Energy Loss Spectroscopy  
*J. Mayer*

## C Technology

- C1      Non-optical Lithography  
*C. Sotomayor-Torres*
- C2      Layer Deposition I: Physical Vapor Deposition  
*A. Förster*
- C3      Layer Deposition II: Chemical Vapor Deposition  
*H. Hardtdegen*

- C4 Layer Deposition III: Langmuir-Blodgett Films  
*R. Zorn*
- C5 Formation of nanostructures by self-organization I:  
Self-assembly of nanostructures at surfaces  
*B. Voigtländer*
- C6 Formation of nanostructures by self-organization II:  
Synthesis and Self-Assembly of nanoparticles  
*U. Simon, M. Homberger*
- C7 Formation of nanostructures by self-organization III:  
Chemical Self-assembly approach to nanoscale architectures  
*S. Karthäuser*
- C8 Scanning Probe Manipulation Techniques  
*G. Meyer*
- C9 Nanostructures and their manipulation at solid/liquid interfaces -  
An electrochemical approach  
*Th. Wandlowski*

## D Concepts for Nanoelectronic Devices

- D1 Design Complexity of Future Integrated Circuits  
*T. Noll*
- D2 Metallic Nanowires  
*K. Takayanagi*
- D3 Semiconductor Spintronics  
*B. Beschoten*
- D4 Scaling Effects of Nanostructured Memories  
*R. Waser*
- D5 Resonant Tunneling Barrier Systems  
*M. Indlekofer*
- D6 Single Electron Devices  
*J. Weis*
- D7 Single Electron Tunnelling Circuits  
*J. Hoeckstra*
- D8 Carbon Nanotube Electronics  
*J. Appenzeller*
- D9 Molecular Electronics  
*M. Mayor, H. Weber*