

Fabrication and Utilization of Mechanically Controllable Break Junction for Bioelectronics

Dong Xiang

Forschungszentrum Jülich GmbH
Peter Grünberg Institute (PGI)
Institute of Complex Systems (ICS)
Bioelectronics (PGI-8/ICS-8)

Fabrication and Utilization of Mechanically Controllable Break Junction for Bioelectronics

Dong Xiang

Schriften des Forschungszentrums Jülich
Reihe Schlüsseltechnologien / Key Technologies

Band / Volume 36

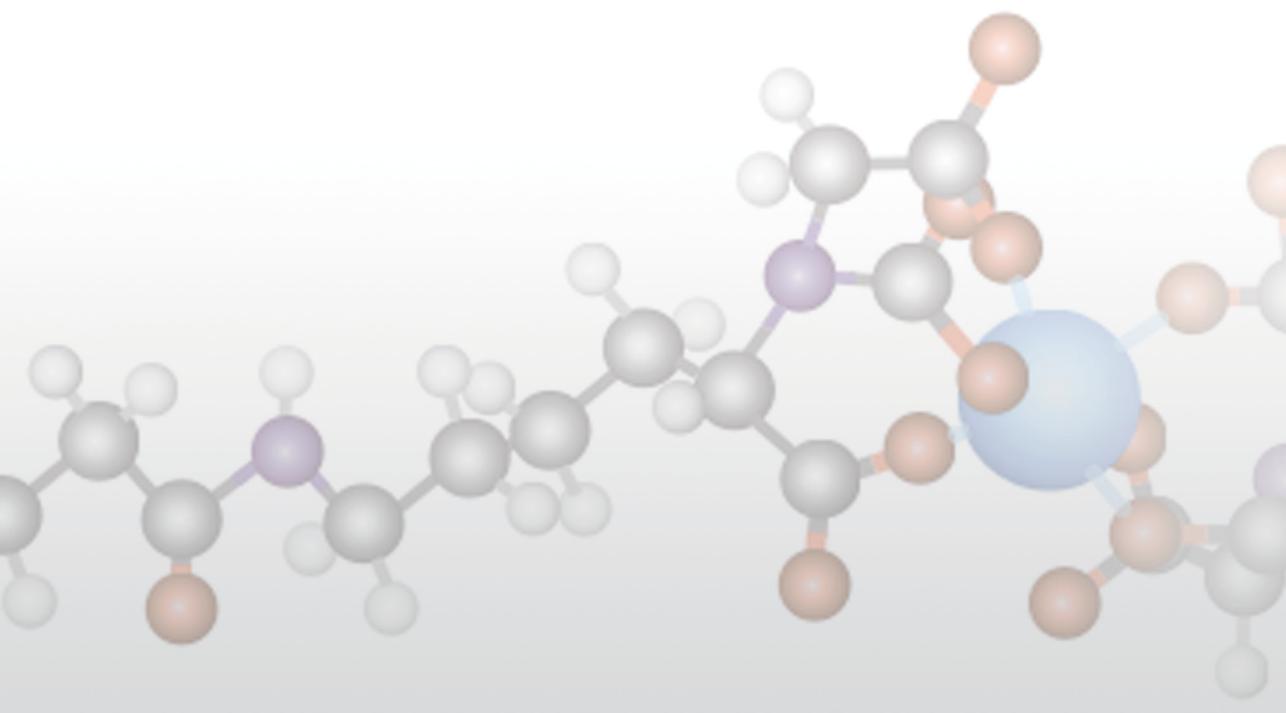
ISSN 1866-1807

ISBN 978-3-89336-769-6

Contents

1	Introduction	1
2	Fundamentals	
2.1	Related Techniques for Nano-Fabrication and Characterization	4
2.1.1	E-Beam Lithography	4
2.1.2	Reactive Ion Etching	8
2.1.3	Nano Structure Image Measurement.	9
2.2	Molecular electronics	13
2.2.1	Approaches of Molecular Electronics	15
2.2.2	Mechanical Controllable Break Junction	18
2.2.3	Electron Transport in Molecular Junction	22
2.2.4	Ligand Field Theory	31
2.2.5	Density Functional Theory.	33
2.3	Noise spectroscopy.	42
2.3.1	Noise-Generating Mechanisms.	42
2.3.2	Noise Detection	45
3	Material and Devices	46
4	Experiments, Results and Discussions	
4.1	Fabrication and Characterization of MCBJ	55
4.1.1	Micro-wire Fabrication	55
4.1.2	MCBJ Chips Fabrication	58
4.1.3	Attenuation Factor Calibration	63

4.2 Noise characterization of Molecular Junctions	68
4.2.1 Noise Spectra of Molecule free Junctions	69
4.2.2 Noise Spectra of Molecule Containing Junctions	70
4.3 Transition Voltage Spectroscopy (TVS) of Molecular Junctions	79
4.3.1 Gap Size Dependence of TVS in Single Molecule Junction	79
4.3.2 Independence of TVS on the Number of Bridged Molecules	84
4.4 Molecular Junction Based on Metal Ion Bonding	89
4.4.1 Molecular Junctions Bridged by Metal Ion Complexes.	89
4.4.2 Dependence of Junction Conductance on Kind of Metal Ion	94
4.4.3 Properties Calculation Based on Density Functional Theory	98
5 Conclusion and Outlook	103
Appendix	107
A Additional Images	107
B Pattern Designs	113
C I-V Curves Fitting Program	115
D Abbreviations	119
Bibliography	121



Schlüsseltechnologien / Key Technologies
Band / Volume 36
ISBN 978-3-89336-769-6

