Johannes Kepler University Linz (Public University)

Linz, Austria

Department of Applied Experimental Biophysics, Institute of Biophysics

- **Nanoscopic techniques in life science, bio-nano-technology, and medical diagnostics**
- **Application and development of atomic force microscopy based methods in life science:**

  Single molecule force spectroscopy, molecular recognition force microscopy, elasticity mapping, recognition imaging, and high-speed AFM

Our group has been or is involved in 12 EU projects

Contact

Priv.-Doz.in Dr.in Yoo Jin Oh
Institut für Biophysik/Abteilung für Angewandte und experimentelle Biophysik
yoo_jin.oh@jku.at, +43 732 2468-7644

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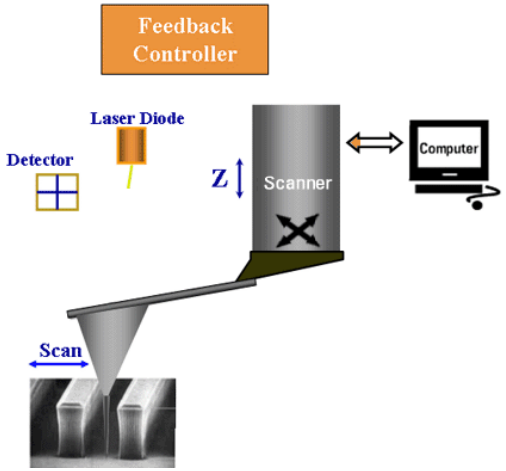
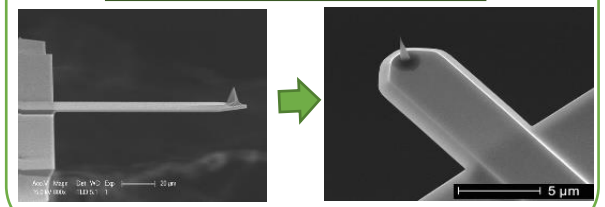
Introduction: Scanning Probe Microscopy

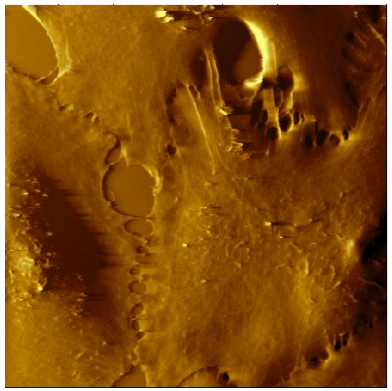


Schematic diagram of general SPM

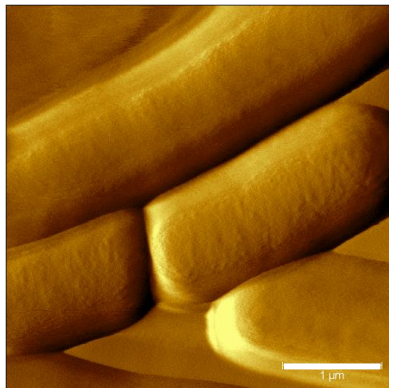
- High resolution - Vertical 0.1 Å, Lateral 2~3 Å
- Easy sample preparation
- Can be operated in air, liquid and vacuum
- combine with optical microscopy
- nanomanipulation with nanoindentation
- various application

Cantilever Dimension

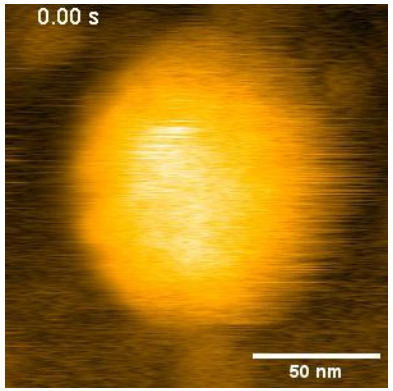




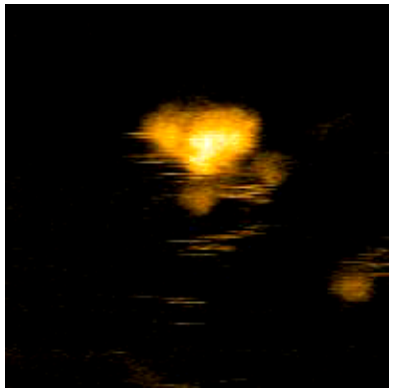
Cell imaging



Bacteria imaging



Virus imaging



Protein imaging

Biophy. J, 1666, 2012
ACS Appl. Mater. Interfaces, 49176, 2024
The EMBO Journal e108375, 2021

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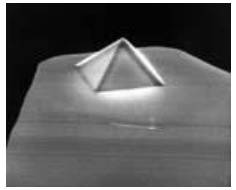
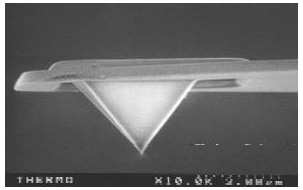
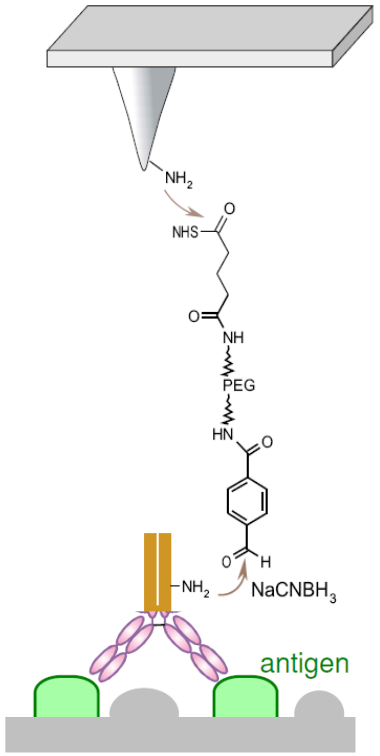
Single Molecule Force Spectroscopy Approach



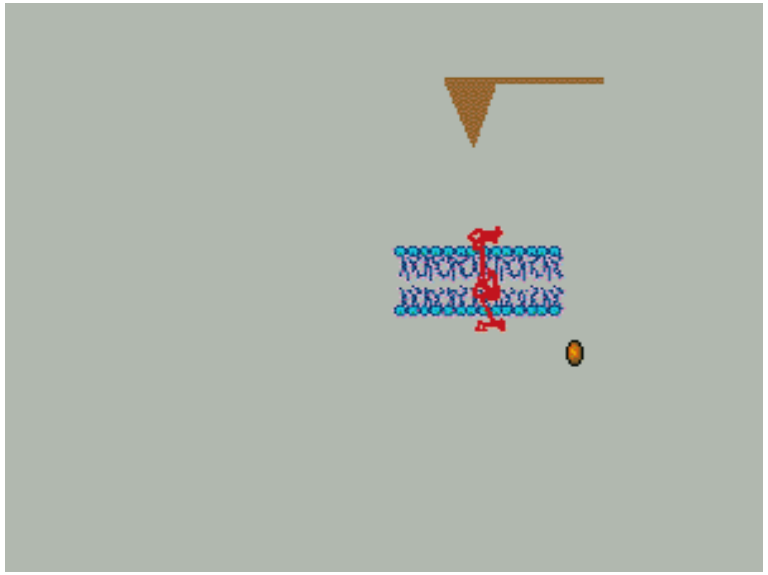




Tip modification via different residues

i) Amine functionalization of Si_3N_4 tip with ethanolamine
ii) Covalent binding of PEG linker to amine group on the AFM tip
iii) Linking of ligand to the end of PEG

=> Ligand can freely move and reorient rapidly, resulting in unconstrained binding



Single molecule force spectroscopy

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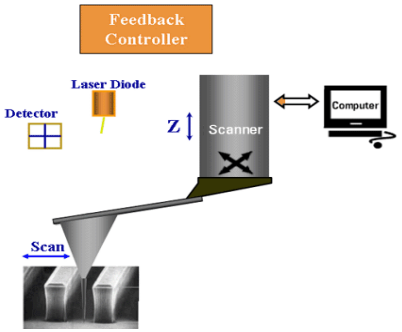
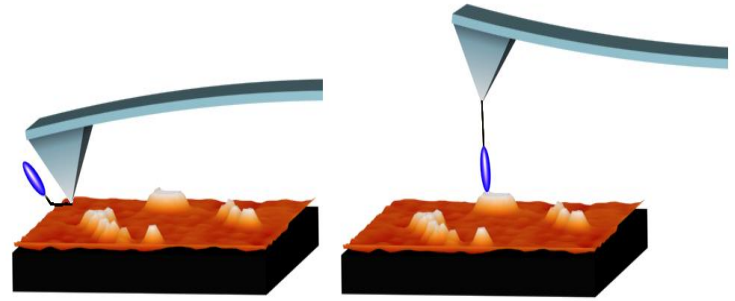
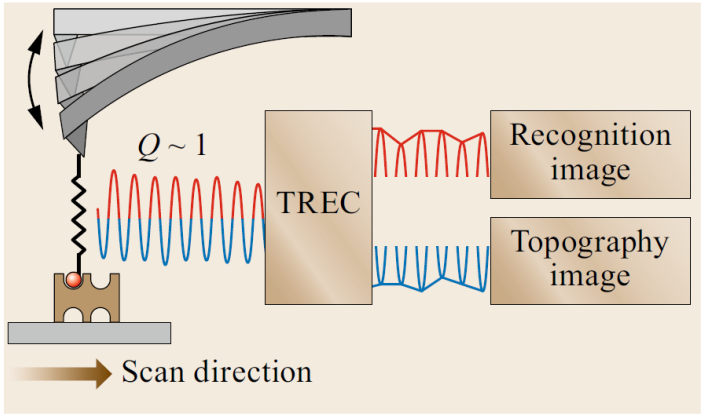
Molecular Sensing Platform: Technical Development



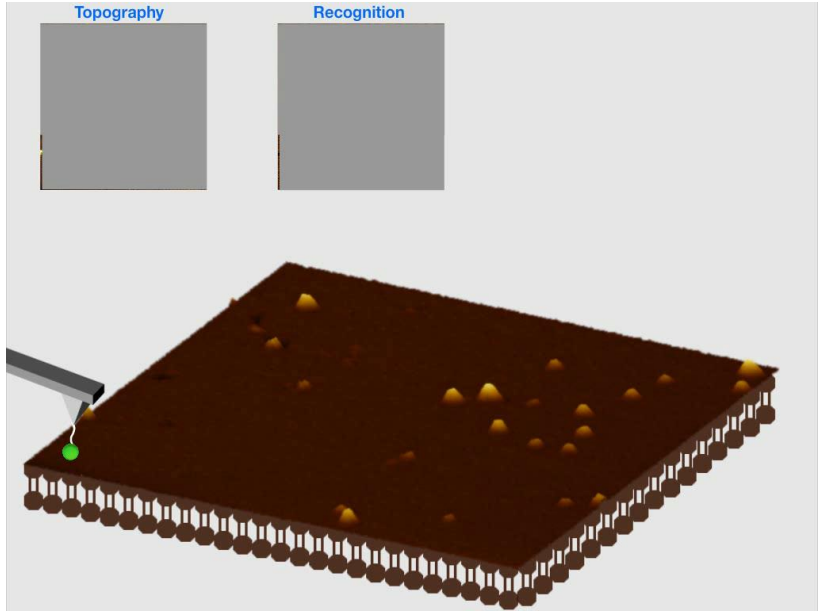
Schematic diagram of general SPM





Recognition:
Amplitude Reduction on Top

Topography:
Amplitude Reduction on Bottom



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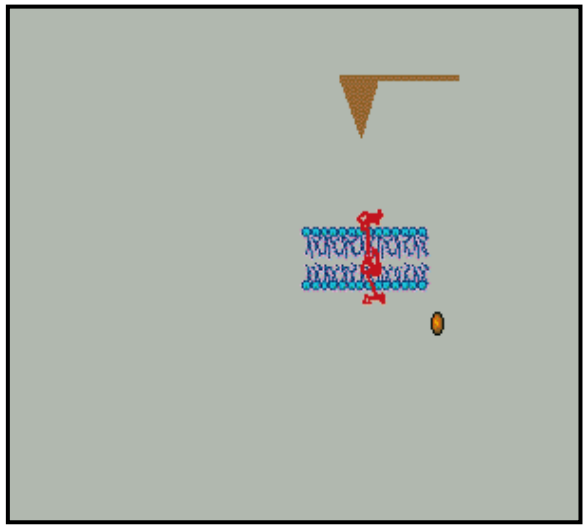
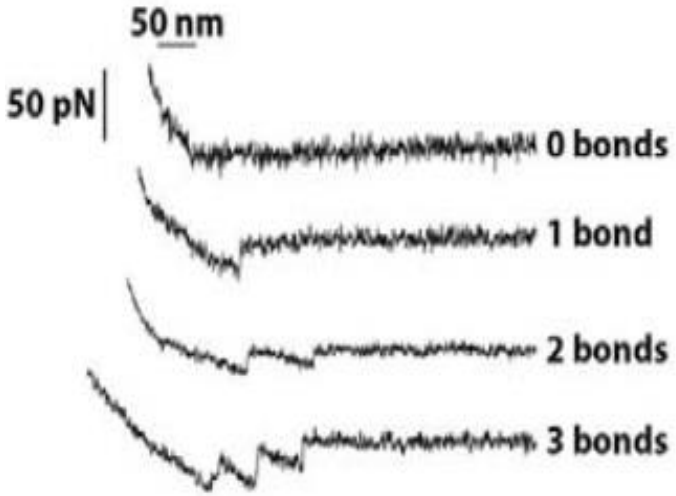
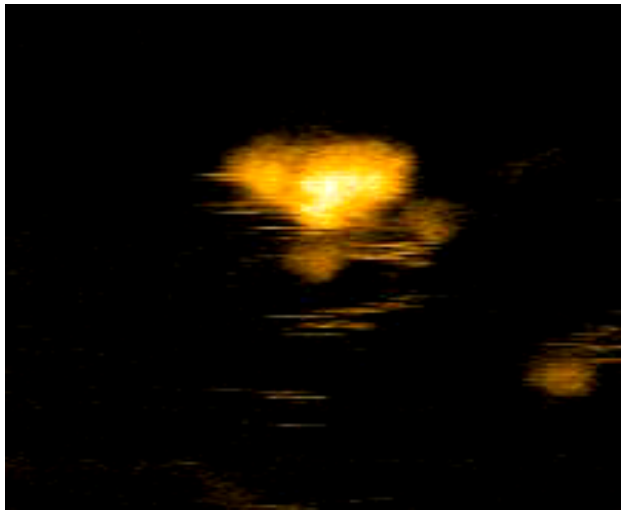
Distribution of Bond Strength and Location





Dance of spike



Article

TRANSPARENT PROCESS OPEN ACCESS

THE EMBO JOURNAL

Identification of lectin receptors for conserved SARS-CoV-2 glycosylation sites

David Hoffmann[1,†], Stefan Mereiter[1,†], Yoo Jin Oh[2], Vanessa Monteil[3], Elizabeth Elder[4], Rong Zhu[2], Daniel Canena[2], Lisa Hain[2], Elisabeth Laurent[5], Clemens Grünwald-Gruber[6], Miriam Klausberger[7], Gustav Jonsson[1], Max J Kellner[1], Maria Novatchkova[1], Melita Ticevic[1], Antoine Chabloz[8], Gerald Wirnsberger[9], Astrid Hagelkruys[1], Friedrich Altmann[6], Lukas Mach[10], Johannes Stadlmann[1,6], Chris Oostenbrink[11], Ali Mirazimi[3,12], Peter Hinterdorfer[2] & Josef M Penninger[1,8,*]

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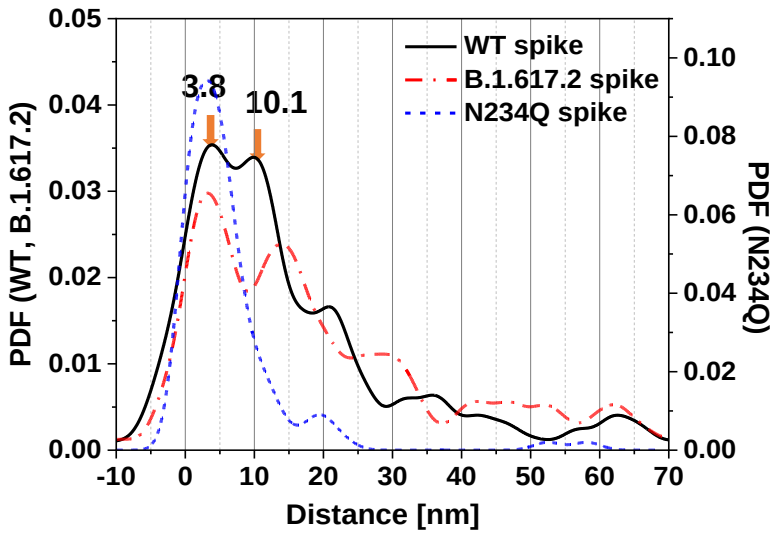
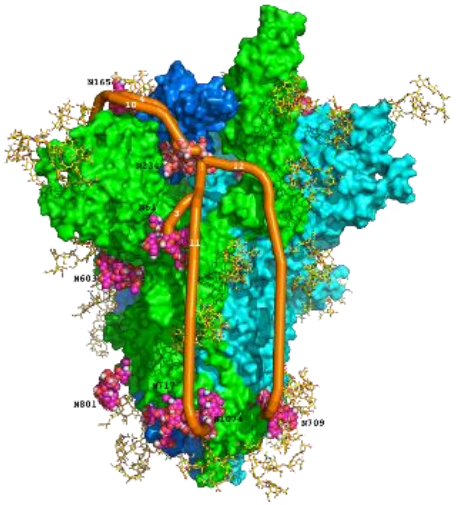
Distribution of Bond Strength and Location



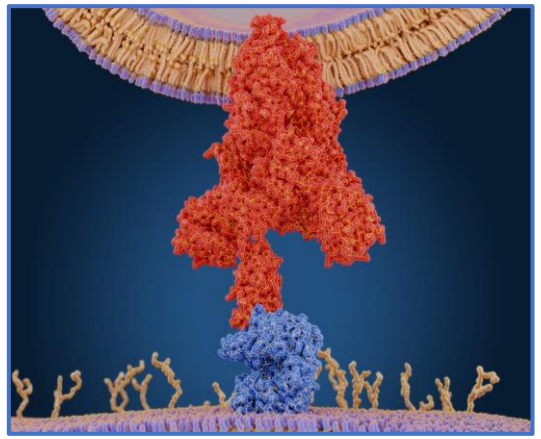


nature communications

Article

https://doi.org/10.1038/s41467-022-35641-3

Force-tuned avidity of spike variant-ACE2 interactions viewed on the single-molecule level



Cell Reports
Medicine

Article

A molecularly engineered, broad-spectrum anti-coronavirus lectin inhibits SARS-CoV-2 and MERS-CoV infection *in vivo*

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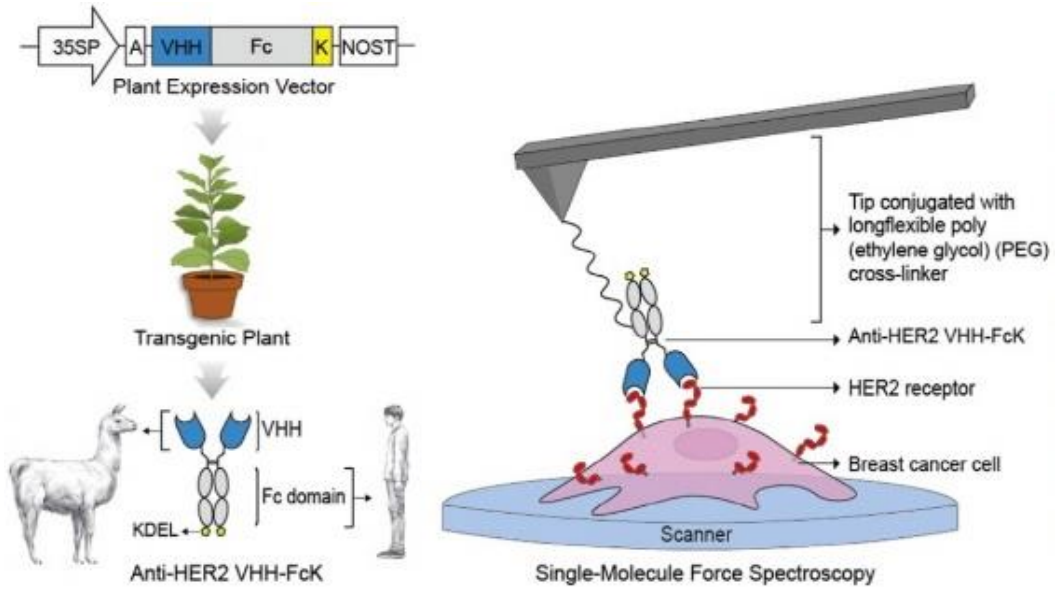
Bivalent Binding Mechanisms of Antibody



- **Comparison of Therapeutics**
- **Advantages of Plant-Based Antibodies**
- **Expanded Therapeutic Efficacy**
- **Bivalent Binding Mechanism**

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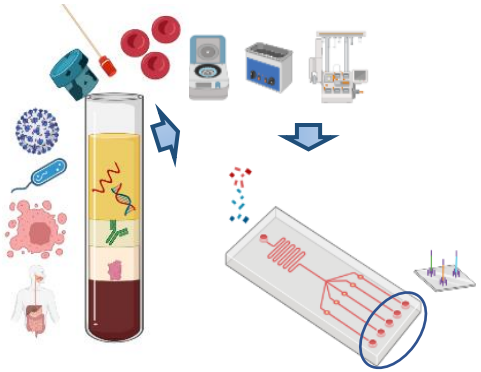
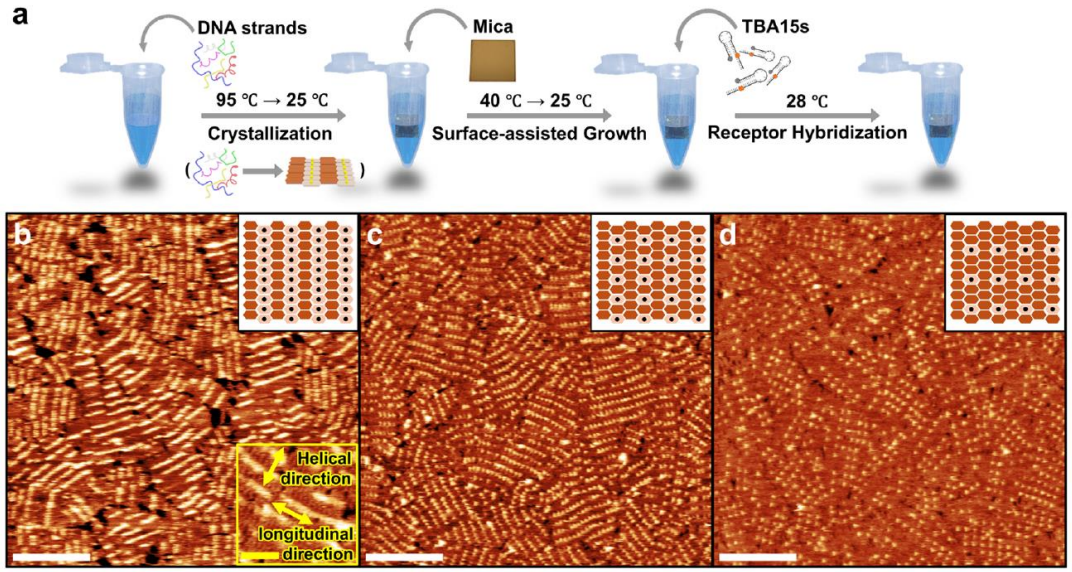
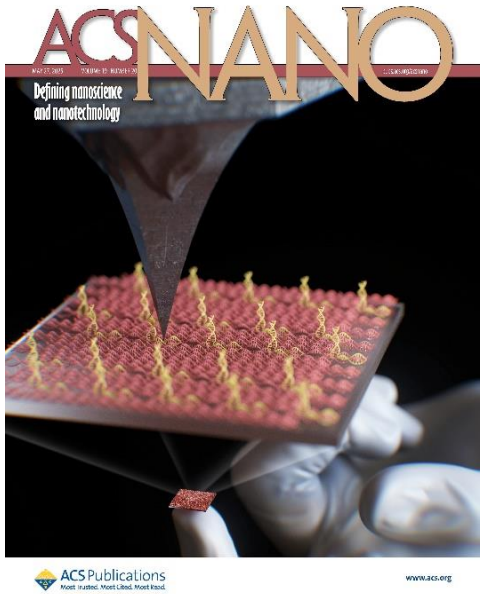
DNA Tile-Based Sensing Surface







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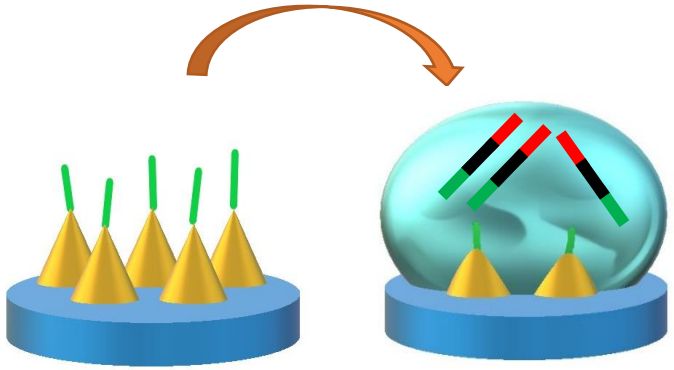
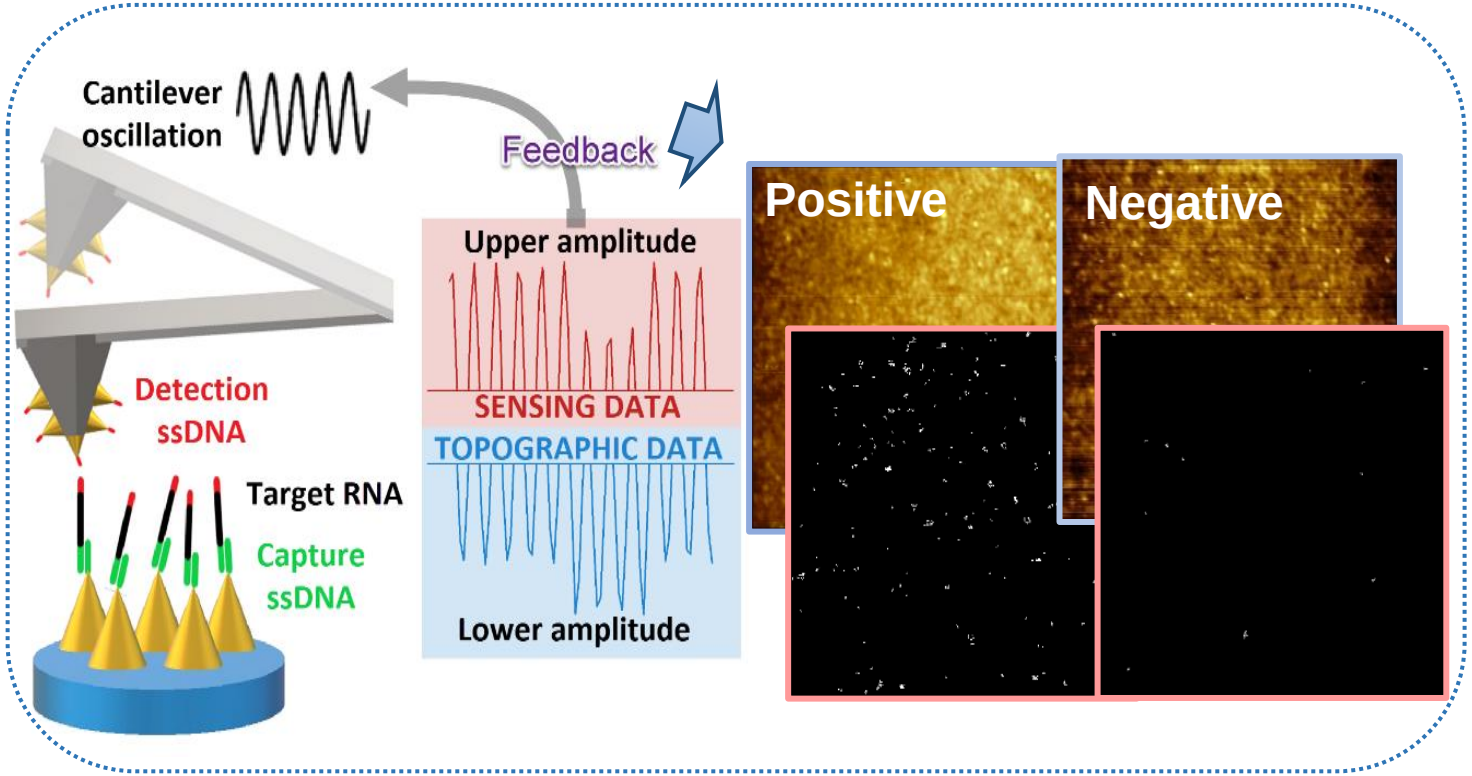
Diagnostic Application in Molecular Sensing



Hybridization



NANO LETTERS
Letter
Cite This: Nano Lett. 2019, 19, 612−617
pubs.acs.org/NanoLett

Ultra-Sensitive and Label-Free Probing of Binding Affinity Using Recognition Imaging

Yoo Jin Oh,[†] Melanie Koehler,[†,§] Yoonhee Lee,[‡,∥] Sourav Mishra,[‡] Joon Won Park,[‡] and Peter Hinterdorfer*[,†]

[†]Institute of Biophysics, Johannes Kepler University Linz, Gruberstrasse 40, A-4020 Linz, Austria

[‡]Department of Chemistry, Pohang University of Science and Technology, 77 Cheongam-Ro, Nam-Gu, Pohang 37673, Republic of Korea

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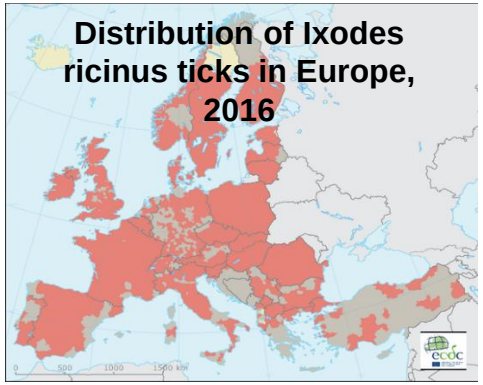
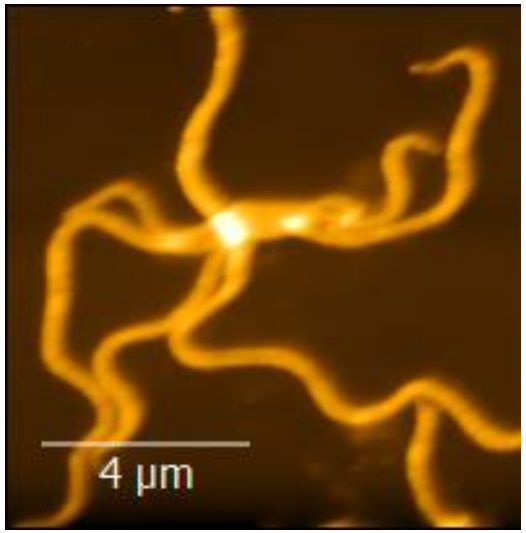
SPM Application to Microbiology



Lyme Borreliosis

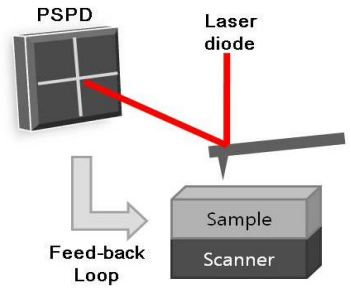


communications biology

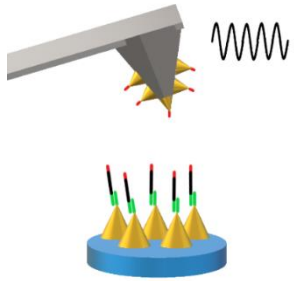
ARTICLE

https://doi.org/10.1038/s42003-021-01783-1 OPEN

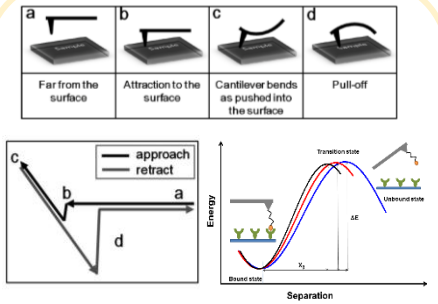
Nanomechanical mechanisms of Lyme disease spirochete motility enhancement in extracellular matrix



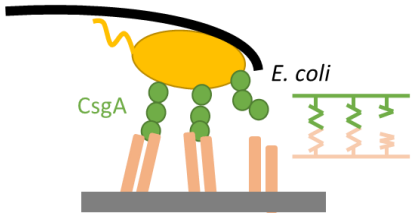
SPM imaging



Topography and Recognition imaging



Force spectroscopy



Interaction analysis

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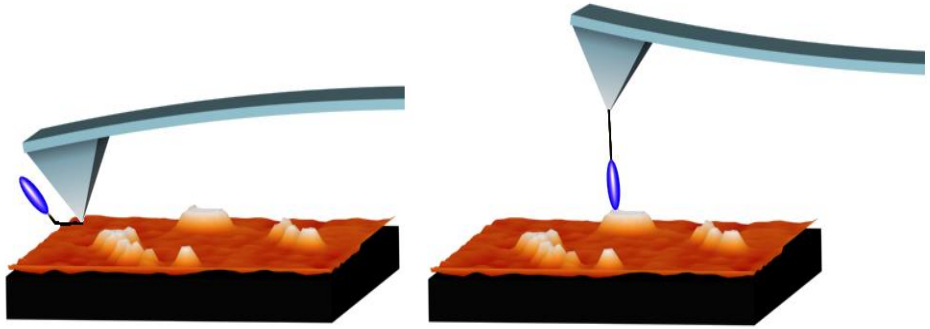
Our expertise

Imaging at nano-scale

- Living cell / bacterial cell
- Protein
- DNA / RNA



Molecular recognition

- Living cell / bacterial cell
- Protein / DNA
- Specific interaction
- Single molecule detection

Force measurements

- Single molecular force spectroscopy
- Kinetic rates
- Energy landscape
- Cantilever modification (protein, DNA, antibody, cell)

Mechanical properties

- Elasticity mapping
- Adhesion mapping
- Single cell/bacteria level

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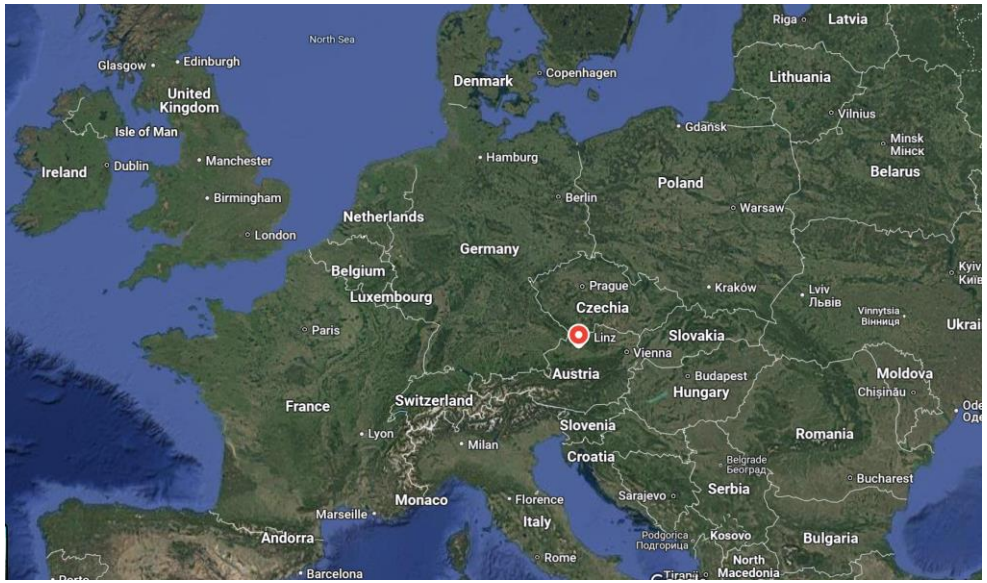
Cluster of Excellence - Microplanet

FWF Österreichischer Wissenschaftsfonds



JKU Institute of Biophysics

OeAD

OAW Österreichische Akademie der Wissenschaften

MARIE CURIE ACTIONS

Contact

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Institut für Biophysik/Abteilung für Angewandte und experimentelle Biophysik
yoo_jin.oh@jku.at, +43 732 2468-7644

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