

Nano-Microbiology

Single Molecular Bond Analysis of Borrelial Adhesins

With approximately 65,500 patients annually, Lyme Disease is the most common arthropod-borne disease in Europe. Various *Borrelia* genospecies such as *B. afzelii*, *B. garinii* and *B. bavariensis* are the causative agents for the larger part of the cases in Europe. These bacteria are transmitted by hard ticks of the *Ixodes ricinus* species complex.



Figure 1 - Scanning Electron Microscopy (SEM) picture of *B. burgdorferi*

Atomic Force Microscopy (AFM)

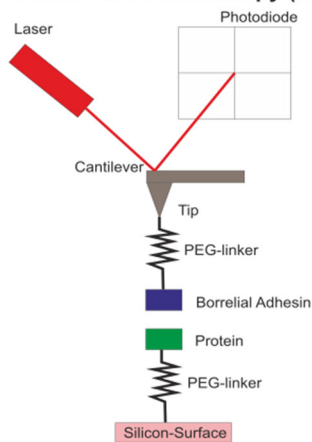


Figure 2 - For force detection a laser is focused on the backside of an AFM cantilever and its deflection is measured with a photodiode

Atomic force microscopy (AFM) based single molecule force spectroscopy (SMFS) will be employed to quantify specific binding strengths of single bio-molecular adhesive interactions, thereby elucidating binding modes, dissociation forces and interaction energy landscapes between borrelial adhesins and ECM components.

Tasks performed by the student:

- Tip-Chemistry: Functionalization of tips and surfaces with borrelial adhesins and ECM proteins for SMFS experiments
- Force Spectroscopy: Single Molecule Force Spectroscopy experiments
- Data evaluation and binding models

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A crucial factor for colonization in the host are sticky proteins, so-called adhesins, which allow the bacteria to attach to other cells.

Borrelia are able to interact with various extracellular matrix (ECM) components upon entry into a new host, allowing them to colonize on a broad range of tissues. During later stages of infection, binding to different ECM components provides a protection for the *Borrelia* against the host's immune system, leading to persistent infections.

The goal of this project is to determine and characterize the extent of molecular interactions between ECM components and selected

adhesins of the dominant pathogenic *Borrelia* species in Europe, *B. afzelii*, *B. garinii* and *B. bavariensis*.

Force - Distance Curve

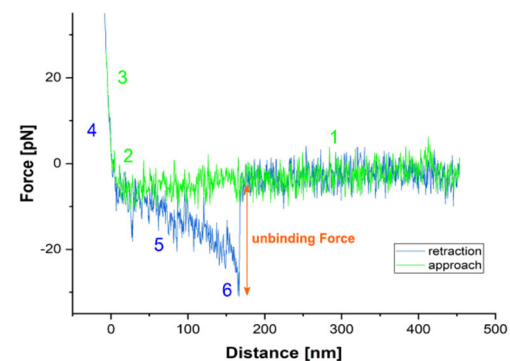


Figure 3 – Force-Distance Curve

1. Cantilever approaches
2. Contact between surface and tip
3. Upward deflection of the cantilever due to contact
4. Retraction of the cantilever
5. Downward deflection due to interaction
6. Dissociation force is reached, leading to breakage of the bond