IMPRS on Multiscale Biosystems

Project description

Title: Coiled coils as mechanical building blocks
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In collaboration with: Beate Koksch (FU)

Project description: Coiled coils (CCs) are important structural motifs found in many different proteins. They are made of α-helices that self-assemble into helical superstructures such as dimers (Fig. 1), trimers and tetramers. In Nature CCs are important components of cytoskeletal and extracellular matrix proteins, indicating their importance as critical mechanical building blocks. Despite their widespread appearance in these structural proteins, little is known about their mechanical properties. This knowledge is crucial for controlling the folding and stability of individual CCs, and more importantly for understanding the mechanical properties of biological tissues.

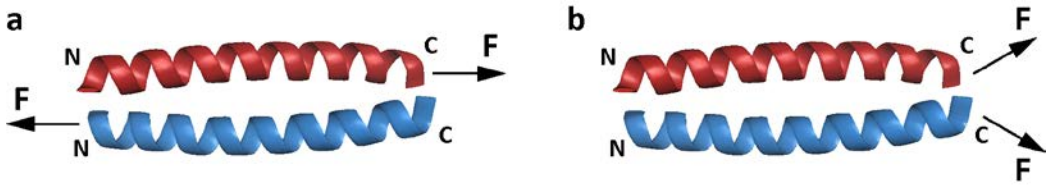

Figure 1. Mechanical separation of coiled coils (CCs). The force can be applied in two fundamentally different geometries. In geometry A all bonds need to break simultaneously (shear). In contrast, the CC unfolds in a zipper like fashion in geometry B. It is expected that the force required to separate the CC will depend on the 'pulling geometry'.

In this project you will investigate the mechanical properties of CCs using a single-molecule approach. Using an atomic force microscope, you will perform-single molecule force spectroscopy to determine the unfolding forces of CCs as a function of primary structure and oligomerization state. More importantly, you will use different positions for applying the force on the CC to investigate if the 'pulling geometry' has an influence on CC stability (Fig. 1). Ultimately, once the basic principles are understood, you will utilize this knowledge to design new, stimuli-responsive CC sequences and to investigate the application potential of these CCs as mechanical building blocks in protein-based materials (such as extracellular matrix mimics).

Required background: You should have a background in experimental biophysics or physical chemistry. Experience in basic organic synthesis and peptide chemistry will be an advantage.

Papers to read before the interview: K. Pagel & B. Koksch. Following polypeptide folding and assembly with conformational switches, *Curr. Opin. Chem. Biol.,* **2008**, *12*, 730-739

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