Recovery Behavior of Single Vimentin Filaments

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Intermediate filaments (IFs) are believed to have an important impact on determining the mechanical properties of cells. Together with microfilaments and microtubules they form dense networks, which compose the cytoskeleton. In order to determine the impact of individual IFs on the overall network, we perform stretching experiments on the single filament level. Optical tweezers, combined with microfluidics and fluorescence microscopy, are used to directly probe the stress-strain behavior of single IFs.
Previous experiments showed that under strain, α-helices in IFs uncoil to β-sheet like structures. Here, we stretch single vimentin IFs up to the plateau region where the uncoiling takes place and relax them again. The relaxation shows no plastic deformation and therefore it is suggested to be a reversible process even though the energy barrier between these two states is comperatively high. To investigate the filament recovery after the uncoiling, a second cycle of stretching and relaxation is performed after waiting times of different duration. Our results show that the initial tensile behavior can not be recovered. However, treatment of the filaments with chemical crosslinkers restores full reversibility.