Tuning the mechanics of single intermediate filaments

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Intermediate filaments (IFs), together with microfilaments (MFs) and microtubulues (MTs), give cells specific and unique mechanical properties as part of the cytoskeleton. Whereas MFs and MTs are conserved between cell types, IFs are expressed in a cell type specific manner. Vimentin IFs, found in cells of mesenchymal origin, have a remarkable potential for elongation and high stability [1,2]. To understand the mechanisms within IFs that determine the mechanical response to stress, single IFs are investigated in vitro using a setup that combines optical tweezers, fluorescence microscopy and microfluidics. By changing the environment (pH, buffer, ion valency and ion concentration) different force-strain behaviours of single vimentin IFs are observed in stretching experiments. IFs show a remarkable dependence on the buffer pH and presence of cations while the cation valency seems to be negligible. With these experimental results and Monte-Carlo simulations [3], we can link changes of the molecular architecture of vimentin IFs to their mechanical response.

[1] J. Block et al., Phys. Rev. Lett. 118 , 048101 (2017).

[2] J. Block et al.. Science Advances 4 , eaat1161 (2018).

[3] C. Lorenz et al., BioRxiv, doi.org/10.1101/676197 (2019).