Lateral Subunit Coupling Determines Intermediate Filament Mechanics

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The cytoskeleton is vital for cell motility, cell division and mechanical stability of the cell. These tasks are distributed among three different protein classes, microfilaments (MFs), microtubules (MTs) and intermediate filaments (IFs). Unlike MFs and MTs, IFs are expressed in a cell-type specific manner [1–3] giving the cell a tool to adapt to different mechanical requirements. So far, the mechanical properties of different IFs on a single filament level have not been probed. Therefore, we study the stress-strain behavior of two IFs, vimentin and keratin filaments, by optical trapping in combination with fluorescence microscopy and microfluidics [4-6]. In comparison to keratin IFs, vimentin IFs are stiffer [6] and dissipate more energy, which predestines vimentin to act as a cellular “safety belt” [4-6]. Monte-Carlo simulations based on theoretical modelling allow the decoupling of different IF-type depending parameters like the monomer interaction and the number of monomers per cross-section of the IF. The obtained parameter distributions show that more energy is required to extend vimentin IFs than keratin IFs [6]. This behavior can possibly be explained by a compaction step of vimentin during IF assembly which is not observed for keratin IFs.

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