AFM AND FORCE SPECTROSCOPY OF RECOMBINANT SPIDER DRAGLINE SILK PROTEIN NANOFIBERS .

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Despite its remarkable materials properties, the structure of spider dragline silk has remained unsolved. Results from two probe microscopy techniques provide new insights into the structure of spider dragline silk. A soluble synthetic protein from dragline silk spontaneously forms nanofibers, as observed by atomic force microscopy. These nanofibers have a segmented substructure. The segment length and amino-acid sequence are consistent with a slab-like shape for individual silk protein molecules. The height and width of nanofiber segments suggest a stacking pattern of slab-like molecules in each nanofiber segment. This stacking pattern produces nano-crystals in an amorphous matrix, as observed previously by NMR and X-ray diffraction of spider dragline silk. The possible importance of nanofiber formation to native silk production is discussed. Force spectra for single molecules of the silk protein indicate a module size of ~14 nm, which corresponds to the extended length of a single repeated module, 38 amino-acids long. The structure of this spider silk protein is distinctly different from the structures of other proteins that have been analyzed by single-molecule force spectroscopy, and the force spectra show correspondingly novel features. This work was supported by NSF MCB.