Peptide Nanotubes: Redesigning Amyloid-B as a Metalloprotein

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With the development of continually shrinking technology, the subject of nanomaterials has become an increasingly relevant topic. Peptide nanotubes have a unique ability to self-assemble providing numerous possibilities for designs and applications. Little is known, however, about these nanotubes, and research was done to elucidate their nature and modify them to be biologically applicable. A seven residue peptide, KLVFFAE, from the protein, amyloid beta, served as the base sequence. This peptide self-assembled into fibers in a neutral pH environment and into bilayer nanotubes in an acidic pH environment. It was hypothesized that these bilayer nanotubes only formed because of the hydrophobic core of LVFFA and the subsequent protonation of the terminal glutamic acid in the acidic environment. With solid phase peptide synthesis, cleavage, and purification, two new sequences, KLVFFAL and HLVFFAL, were created. After transmission electron microscopy and infrared spectroscopy, the two sequences proved, respectively, that the terminal glutamic acid was responsible for pH dependence and that the electrostatic repulsion of the terminal lysine's created this bilayer. This new congener, HLVFFAL, could also bind to copper II ions, a metal known for its paramagnetic properties. Thus, the results provided key information on the mechanics behind the driving forces of self-assembling nanotubes; in addition, the ability to control the morphology of these peptides, which can also bind to metals, opens up a host of possibilities, including being able to interact as metalloenzymes, act as biosensors for diseases, and play a role in nanoelectronics.

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