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Abstract

Self-assembled Nanostructures in Nature and Routes to Biomimicry
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While biological systems are often infamous for their complexity, sometimes nature displays mechanisms that are elegant in their simplicity. We believe we have identified such a mechanism at work to enhance the mechanical strength of various natural adhesives. The mechanism is simple because although it relies on the self-assembly of protein molecules it appears to be a mechanism independent of amino-acid sequence. This characteristic makes it an ideal target for biomimicry.

Using the atomic force microscope (AFM) we have directly probed the nanoscale mechanical properties of natural adhesive extracellular matrices of terrestrial algae *in vivo.* Force-extension curves displayed unexpectedly regular mechanical responses indicating a highly ordered ultrastructure within the adhesive. Additional mechanical and histochemical evidence leads us to believe that the ordered mechanical responses are due to mechanically manipulating β-sheets within highly ordered amyloid quaternary protein structures.

Amyloid fibrils are normally associated with neurodegenerative diseases however recently it has been suggested that amyloid fibrils can readily self-assemble from most polypeptides *in vitro* under appropriate conditions, which are usually slightly denaturing. To test this we investigated the conditions necessary to form amyloid structures from readily available and inexpensive heterogeneous sources of protein. Initial results indicate that these interesting structures can be formed readily under denaturing conditions providing a promising starting point for biomimicry and as templates for nanoscale patterns and wires.