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Spiders spring a trap

Web silk is a trampoline of soggy molecular helixes.

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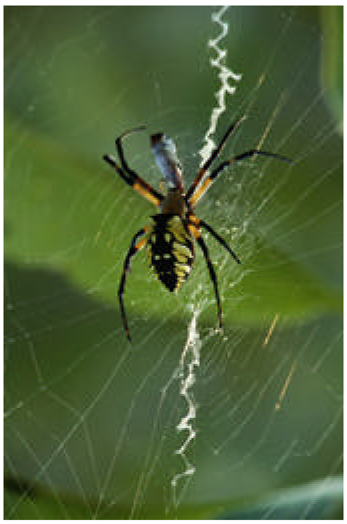

Understanding spider silk may help us develop strong stretchy materials.
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The capture silk spun by spiders contains soggy molecular springs to absorb the impact of an insect flying into their webs. The finding might help materials scientists to improve the synthetic fibres used in strong, lightweight, stretchy fabrics or protective coatings.

If spiders' sticky silk threads were too stiff they would snap when dinner flew into them; too bouncy and they'd shoot it straight out again. Instead they dissipate energy by warming up as they stretch. What's more, the fibres are as strong as Kevlar or steel, thin enough to be invisible to a flying bug, and extendable to up to ten times their initial length.

Helen Hansma of the University of California, Santa Barbara, and colleagues hit on the idea of soggy springs after stretching individual silk molecules with an atomic-force microscope[1]. This device contains a fine needle attached to a cantilever arm.

The researchers dipped the needle into a smear of liquid silk from a common orb-weaving spider on a glass slide. The tip became attached to one or more of the silk molecules. As they pulled the tip away, the bending of the cantilever revealed the force exerted as the silk was stretched out.

Hansma and her colleagues found that spider-silk molecules extend in a series of jumps, like other elastic proteins such as titin in muscle fibres and lustrin in abalone shells. They reckon that this jerkiness is caused by the successive breaking of hydrogen bonds that tie long molecules of capture silk into a compact bundle. Such bonds reform easily when the force is removed and the molecular chain scrunches up again.

But the extension that the researchers saw wasn't simply proportional to the stretching force they applied - as it would have been if the protein were a simple chain of springs linked end to end. They conclude that they were probably pulling on several molecules at once, each stuck to the other in a crosslinked network of springs.

References

1. Becker, N. Molecular nanosprings in spider capture-silk threads.. ***Nature Materials***, **advance online publication**, doi:10.1038/nmat858 (2003).

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