Aiming at gossamer armour

A fly hits a spider's web with an impact equivalent to that of a supersonic jet, mass for mass. Spider silk fibres are 100 times thinner than a human hair, but five times stronger than steel of the same thickness, and may soon find a variety of industrial applications.

According to Nick Ashley, of PA Technology, in Royston, Hertfordshire, the lightness and strength of the fibre, together with its impressive impact-resistant properties, make it an ideal candidate for use in high-tech materials. Even bullet-proof vests might be woven from gossamer thread.

Now researchers have discovered one of the spider's most closely guarded secrets: how it manages to spin a web which has just the right amount of elasticity to absorb the impact of flies.

In the latest issue of *Nature* (vol 340 pp 305-306), Donald Edmonds and Fritz Vollrath, of Oxford University, show how the garden cross spider, *Aranens diadematus*, can transform stiff silk fibres into superbly elastic threads simply by daubing them with a watery glue secreted from a special gland. The spider uses this trick, say the researchers, to vary the mechanical properties of the thread so that the web it spins is perfectly balanced for strength and flexibility.

The garden cross spider weaves its web from two types of thread. The framework is woven from taut, stiff fibres which sag when contracted by only one tenth of their length. But the "capture" fibres, which absorb the impact of flies, are so elastic that they can shorten to a twentieth of their length and still remain taut.

Edmonds and Vollrath show that it is the gluey coating that gives the capture threads their elasticity. Without it, the capture threads become as stiff as framework fibres; but reapply the liquid, and the threads become super-elastic once more. The glue seems to work by allowing the thread to coil up inside tiny glue droplets, like cable in a cable drum.

One difficulty the spider could face, especially in hot weather, is keeping its thread moist after weaving it. But according to Professor R. J. P. Williams and Wayne Fairbrother, also of Oxford University, the liquid is packed with small peptide molecules which slow down evaporation. Ashley hopes to use genetic engineering to mass-produce drag-line silk, the variety of silk which spiders use as safety lines and for abseiling from ceilings.

Drag-line silk is extremely tough and by implanting an artificial version of its gene into bacteria, Ashley and colleagues aim to produce the silk in the laboratory, without spiders.

He also claims that by modifying the synthetic gene it should be possible to redesign the natural fibre in order to produce a whole family of biosilks tailored to perform different tasks. One might be used to weave a material strong enough to stop a speeding bullet.

Ironically, Paul Calvert, of the University of Arizona, commenting on the work of Edmonds and Vollrath in the same issue of *Nature*, suggests that one way to attract funds for research on spiders' webs would be to find an application for them in missile defence systems.

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