Spiders' unspun silk flows easier the faster it is sheared

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Nephila Senegalensis (Golden orb weaving spider).Credit: Oxford Silk Group

Oxford researchers have discovered that spiders and silkworms spin their fibres using methods that are not all that different from commercial spinning.

Professor Fritz Vollrath and colleagues, in the Silk Research Group at the Department of Zoology, have been able to demonstrate that the spinning 'dope' or unspun silk behaves just like a traditional, commercial semi-crystalline polymer, as published today in *Nature Materials*. This discovery has important implications for industry in their attempt to spin artificial silk threads from protein feed-stocks.

The scientists took dope from the glands of spiders and silkworms, and subjected these precursor silks to shear forces similar to those they would encounter in the animals' spinning ducts. Surprisingly, both pre-silks behaved identically under shear, and both flowed easier the faster they were sheared. This is a phenomenon called ‘shear thinning’ and was first described in the 1920’s for molten plastics.

The observation that both silks – having originated separately and evolved over hundreds of millions of years of independent evolution - show identical shear thinning behaviour suggests the key importance of this flow -response for spinning in nature. Silks are spun with water as a solvent, as well as ambient pressures and temperatures, yet they are fibres with material properties that can put top commercial fibres to shame.

Professor Fritz Vollrath said: ‘Copying the spider's trick of making the silk proteins, and spinning them into these tough fibres has been a dream for a long time. The discovery that the spinning process relies on well understood flow physics is a further step towards realising this dream.’

Researchers from the Oxford Silk Group have previously been able to show that nature has evolved some clever tricks to facilitate the mechanics of the spider’s extrusion system.

Lead author Chris Holland, from the Oxford Silk Group, said:’ Using techniques originally developed for the physical sciences and applying them to study nature’s way of creating these high performance materials opens new doors into understanding not only how silks may have evolved, but also how we may take inspiration from them to improve our own materials‘.

Source: University of Oxford