Angewandte Chemie
Eine Zeitschrift der Gesellschaft Deutscher Chemiker

Chefredakteur: Peter Gölitz
Boschstraße 12, 69469 Weinheim

Telefax: +49 (0) 6201/606-331
Telefon: +49 (0) 6201/606-315
E-Mail: angewandte@wiley-vch.de
www.angewandte.de
www.angewandte.org

Nr. 15/2007

Fascinating Spider Silk

Genetically engineered spider silk proteins lead to a better understanding of the spinning process

Stronger than steel and more elastic than rubber: spider silk is unsurpassed in its expandability, resistance to tearing, and toughness. Spider silk would be an ideal material for a large variety of medical and technical applications, and researchers are thus interested in learning the spiders' secrets and imitating their technique. A team lead by Thomas Scheibel at the Technical University of Munich has now made a step in the right direction. As they report in the journal *Angewandte Chemie*, the interaction between hydrophilic (water friendly) and lipophilic (fat friendly) properties of the silk proteins plays an important role in the spinning process.

Fundamentally, the spinning of spider silk represents a phase change from a solution into a solid thread; but the exact details of this process are largely unknown. The silk used by orb weaver spiders to spin the edges and spokes of their webs and to rappel away in the face of danger is made of two different proteins. The Munich team has now successfully used genetic engineering to produce one of the spider silk proteins of the European garden spider (*Araneus daidematus*). While purifying the protein by dialysis, the researchers observed the separation of two different fluid phases. Whereas one phase consisted of protein dimers, the second consisted of oligomers—multiple protein units linked together. After the addition of potassium phosphate, a natural initiator of silk aggregation, the liquid could be pulled into threads. "It is clearly not a structural change in the protein, but rather the degree of oligomerization that is crucial for thread formation," concludes Scheibel.

The silk solution in the spider's silk gland has a very high protein concentration. This solution also contains a high concentration of sodium chloride, which suppresses oligomer formation.

Angewandte Chemie International Edition ist eine Wiley-VCH-Publikation / is a publication of Wiley-VCH.
Sitz der Wiley-VCH Verlag GmbH & Co. KGaA / Location of company: Weinheim.
Vorsitzender des Aufsichtsrats: John Herbert Jarvis
Handelsregister/Trade Register: Mannheim Abt. B, Nr. 2833 W USt.-Id. Nr. DE 813481633
Steuernummer: 47020 / 21620
Persönlich haftender Gesellschafter: John Wiley & Sons GmbH, Sitz: Weinheim
Amtsgericht Mannheim, Abt. B, Nr. 2296 W, Geschäftsführer: William Pesce

If the sodium chloride is removed, the proteins aggregate into oligomers.

In addition, the pH value also plays a crucial role in web production: within the silk gland, the pH is relatively high, but within the spinning duct it drops to a slightly acidic level. No phase separation was observed for the synthetic spider protein when the pH was maintained at an alkaline level. At high pH, the normally uncharged tyrosine groups in the protein are deprotonated, which gives them a negative charge. This charge weakens the interactions between the hydrophobic, lipophilic regions of the proteins, which are necessary for oligomerization.

“Our insights form a foundation for the establishment of an effective spinning process for the production genetically engineered spider silk,” hopes Scheibel.

(2769 characters)

Thomas Scheibel, Technische Universität München, Garching (Germany)
http://www.fiberlab.de/homepages/tom/index_tom.html

The Amphiphilic Properties of Spider Silks Are Important for Spinning
Angewandte Chemie International Edition, Volume 46, Issue 19
doi: 10.1002/anie.200604718

Copy free of charge—we would appreciate a transcript of your article. The original articles that our press releases are based on and annotated tables of contents of the upcoming issues can be found ahead of publication in our online pressroom at http://pressroom.angewandte.org.

Angewandte Chemie International Edition ist eine Wiley-VCH-Publikation / is a publication of Wiley-VCH.
Sitz der Wiley-VCH Verlag GmbH & Co. KGaA / Location of company: Weinheim.
Vorsitzender des Aufsichtsrats: John Herbert Jarvis
Handelsregister/Trade Register: Mannheim Abt. B, Nr. 2833 W USt.-Id. Nr. DE 813481633
Steuernummer: 47020 / 21620
Persönlich haftender Gesellschafter: John Wiley & Sons GmbH, Sitz: Weinheim
Amtsgericht Mannheim, Abt. B, Nr. 2296 W, Geschäftsführer: William Pesce