Unravelling web of mystery behind spider adhesive, could prevent paint from peeling

We have all seen wall paint peeling in places where high humidity is present. Every chemist knows the reason is Interfacial water. It forms a slippery and non-adhesive layer between the adhesive and the surface to which it is meant to stick, interfering with the formation of adhesive bonds between the two. Overcoming the effects of interfacial water is one of the many challenges to face developers and formulators of commercial adhesives.

Researchers at The University of Akron (UA) Ohio USA are looking at spider silk - one of the strongest materials found in natural world. The extremely sticky substance that coats the silk threads of spider webs is a hydrogel, meaning it is full of water.

The American team questioned 'Why spiders have no difficulty in catching prey, particularly in humid conditions? Their tacky glue is one of the most effective biological adhesives in nature. It has been a subject of much research over many years.

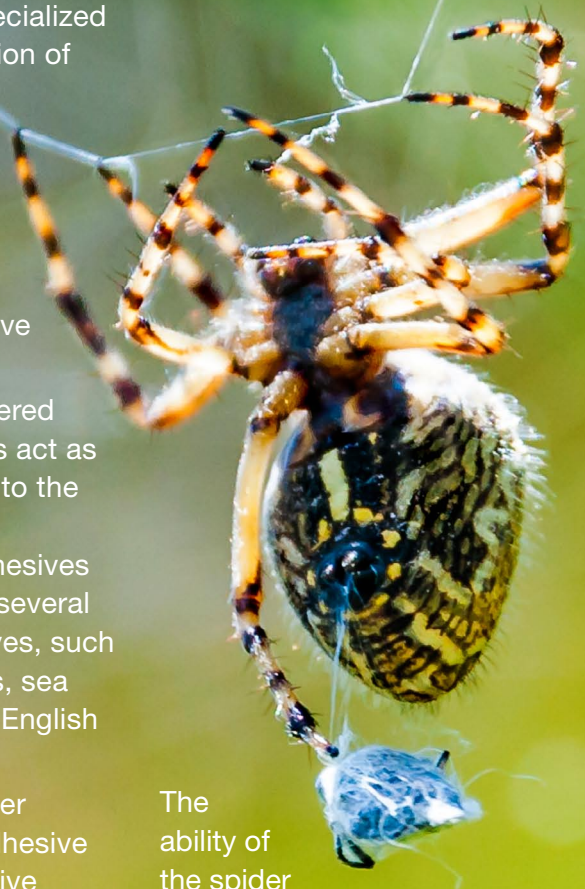
The UA team looked at the common orb spider (Larinioides cornutus) to understand and discover how it's adhesive overcomes the primary obstacle of achieving good adhesion in the humid conditions where water could be present between the adhesive and the surface. They took orb spider adhesive, set it on sapphire substrate, then examined it using a combination of interface-sensitive spectroscopy and infrared spectroscopy.

Spider adhesive is made of three elements: two specialized glycoproteins, a collection of low molecular mass organic and inorganic compounds (LMMCs), and water. The LMMCs are hygro-scopic (water-attracting), which keeps the adhesive soft and tacky to stick.

The researchers discovered that these glycoproteins act as primary binding agents to the surface.

Glycoprotein based adhesives have been identified in several other biological adhesives, such as fungi, algae, diatoms, sea stars, sticklebacks and English ivy.

So why doesn't the water present in the spider adhesive interfere with the adhesive contact the way it does with most synthetic adhesives? The team concluded that the LMMCs perform a previously unknown function of sequestering interfacial water, preventing adhesive failure. The researchers determined that it is the interaction of glycoproteins and LMMCs that governs the adhesive quality of the adhesive produced, with the respective proportions varying across species, thus optimizing adhesive strength to match the relative humidity of spider habitat.



The ability of the spider adhesive to overcome the problem of interfacial water by effectively absorbing it is the key finding of the research, and the one with perhaps the strongest prospect for commercial development.