Beetles in rubber boots: Scientists study ladybirds' feet

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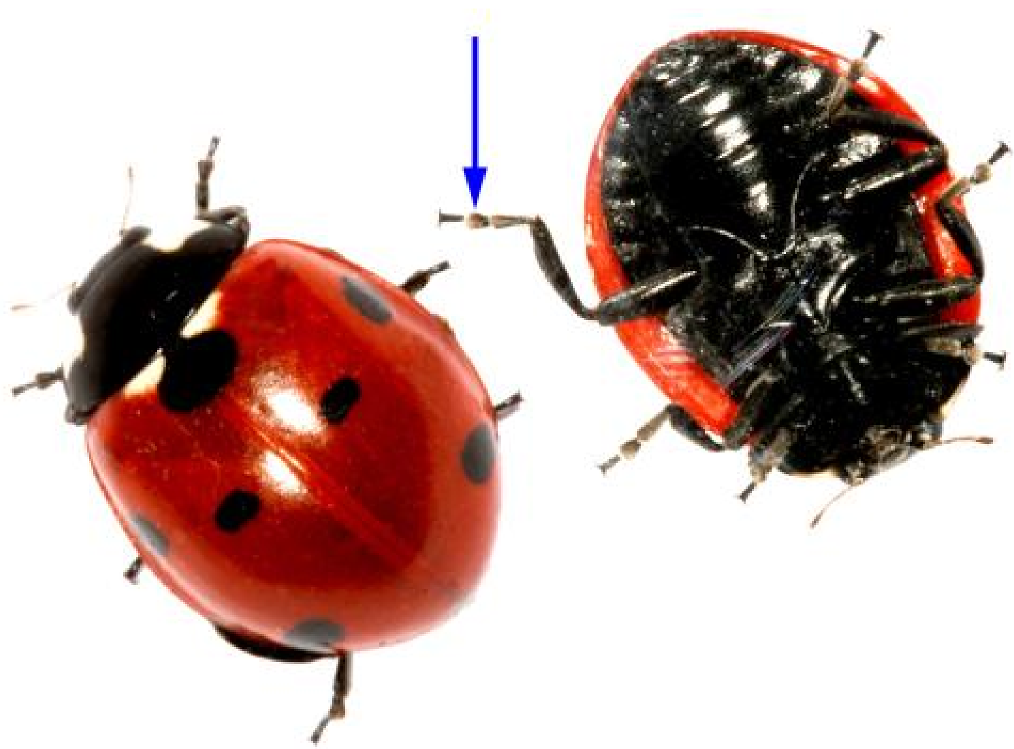
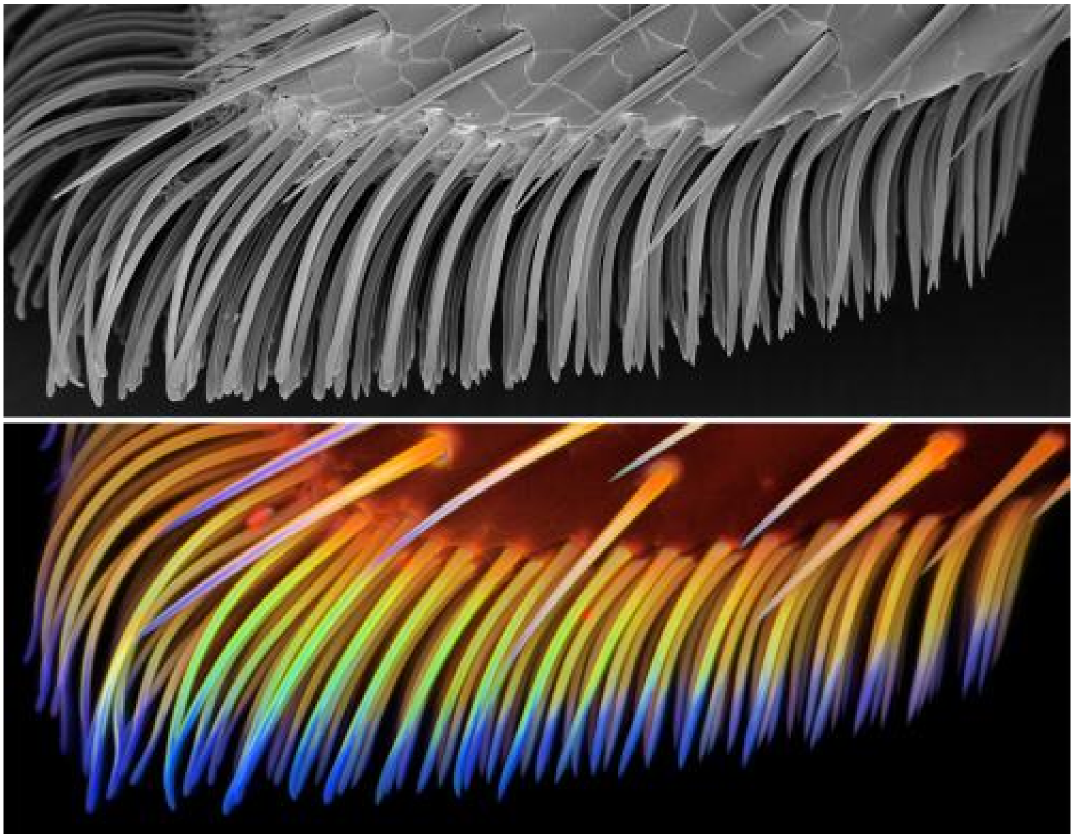


Upper side (left) and lower side (right) of a seven-spot ladybird (Coccinella septempunctata). The blue arrow exemplarily indicates one of the adhesive pads of the ladybird. Credit: Stanislav N. Gorb

During their evolution, insects have developed various unique features to survive in their environment. The knowledge of the working principles of insects' microstructures holds great potential for the development of new materials, which could be of use to humans. With this idea in mind, Dr. Jan Michels, a scientist at the Institute of Zoology at Kiel University, investigates how insects manage to efficiently cling to diverse surfaces. Michels and his colleagues recently published their new findings on the adhesive structures of ladybirds in the scientific journal *Nature Communications*.

A lot of insects are able to climb up walls or walk upside down on surfaces. The new study shows for the first time what astonishing materials allow for these abilities. Using special microscopy techniques, confocal laser scanning microscopy and atomic force microscopy, Michels and his colleagues investigated the legs of ladybirds. "Each leg is equipped with fine adhesive hair, which enable the insect to cling to surfaces in a most impressive way", explains Michels. "Our results show that different parts of the single hair feature varying material compositions and properties. While the bases are relatively hard and stiff, the material in the tips of every single hair is rather soft and flexible." The scientists assume that this enables the tips to adjust to uneven surfaces resulting in a better adhesion to rough substrates.

The research team composed of Dr. Jan Michels, Dr. Henrik Peisker and Professor Stanislav Gorb came upon these findings by visualising the protein resilin, which is responsible for the softness and elasticity of the hair tips. This protein is present in many insect structures with strong resilience properties such as wings, leg joints and, as shown now, adhesive hair of ladybirds.



Adhesive hair of a seven-spot ladybird (Coccinella septempunctata) – made visible with a scanning electron microscope (above) and a confocal laser scanning microscope (bottom). Structures with a high proportion of resilin are depicted in blue. Credit: Jan Michels

Increasing scientific knowledge of nature's tricks represents important fundamental research for the future development and improvement of surface active materials. The scientists can imagine to optimise the basic material used for the so-called Gecko®-Tape, which was developed and characterised by Stanislav Gorb and his team in cooperation with their industry partner. However, the material composition of the ladybird's adhesive hair is so complex that there is currently no material available, which would make such a reproduction possible. "Nature is a ladybird's step ahead of us", jokes Jan Michels. He sets his hopes on materials scientists: "It's their turn now."

More information: Peisker, H., Michels, J. and Gorb, S. Evidence for a material gradient in the adhesive tarsal setae of the ladybird beetle Coccinella septempunctata, *Nature Communications* 4:1661; DOI: 10.1038/ncomms2576

Provided by Kiel University

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