Elucidation and imitation of the structure of the viscous sphere of the weft of the spider web

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[Introduction]

Spider silk is known for its strength, high elasticity, and superior performance. In recent years, humans have succeeded in mass-producing artificial spider silk that has the same properties as natural spider silk, and its application in various fields is expected. As one of them, it is expected to be applied to the electronics field such as sensors. Spider web wefts are characterized by the generation of droplets at specific locations, and if it is possible to control the position of droplet generation on the fiber, a new stretch sensor can be created by coating it with a conductive liquid.

In this study, we aimed to clarify and imitate the method of controlling the position of droplets in spider weft threads. We evaluated and verified the mechanical properties by fabricating threads.

[experiment]

The spider's weft was immersed in a 5 wt% Tween-20 aqueous solution, and the surface of the liquid was wavy with a rotor to separate the coating. After understanding this, we made a model with a diameter of 40 ㎛, coated it with mucus, and confirmed whether or not droplets were generated at specific positions by applying tension. The weft threads of Araneidae belonging to Araneidae were used as the collected threads.

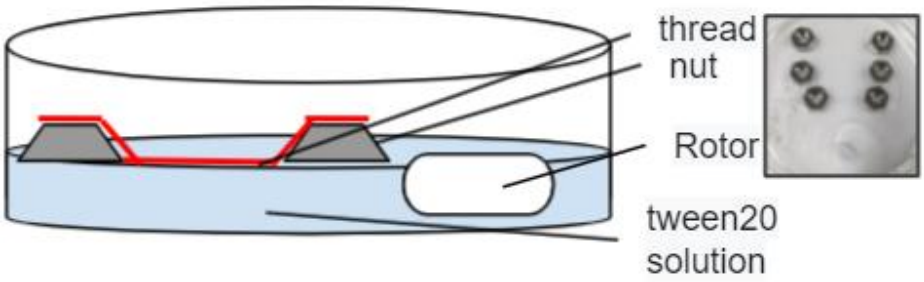

Figure 1 How to remove the coating

[Results/Discussion]

Fig2 is an image of the internal structure of the spider's viscous sphere with the coating removed, taken with an electron microscope. From the image, it was confirmed that the yarn is composed of four fibers and has a characteristic spinning method. Two of them are right-handed, and the whole structure is left-handed. This structure occurs periodically

This structure, which was clarified based on a model made of polylactic acid filaments, was made with a thread four times thicker than the actual spider silk. The size of the sticky ball changed. When the tension was weakened and the viscous spheres disappeared, viscous globules appeared at the same

position when the tension was applied again. From this, this structure is one of the reasons why the viscous ball is generated from the place where the thread is fixed. It was thought that it could be applied to manufacturing.

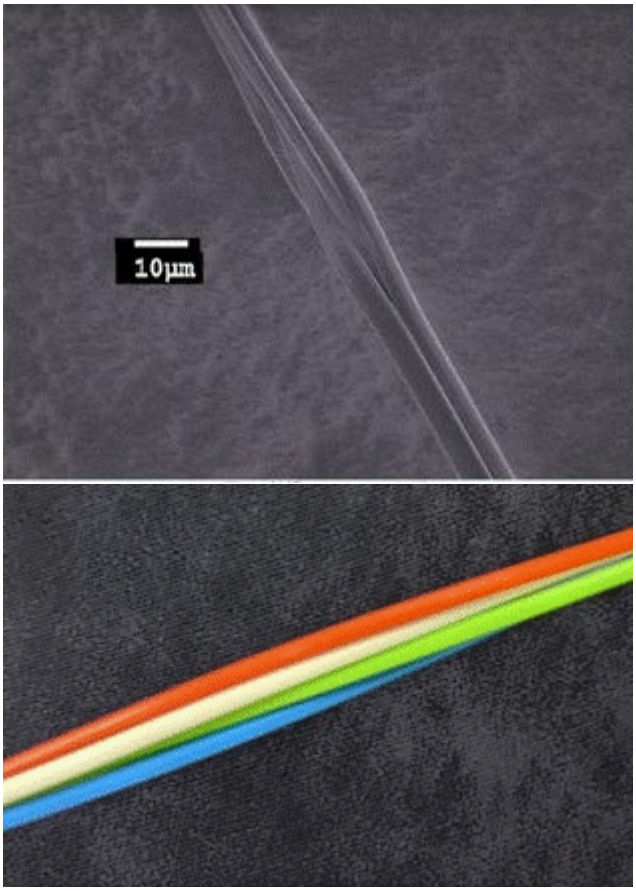

Figure 2 Internal structure

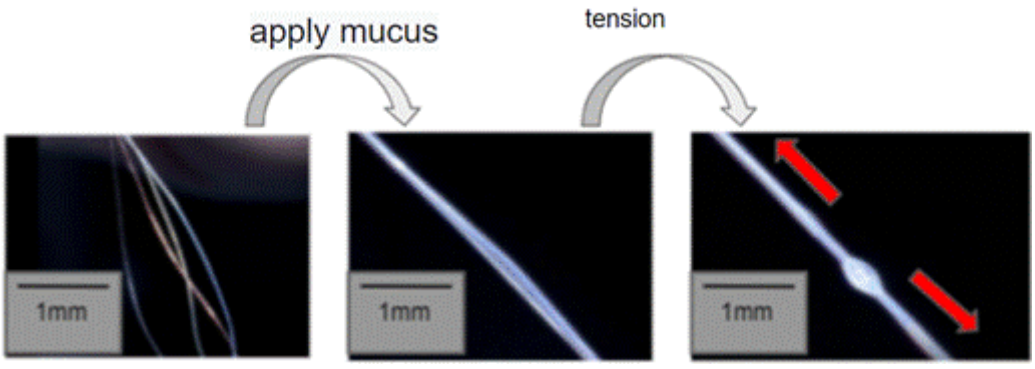

Figure 3 Artificial viscous sphere