Glowworm Capture Threads Studied by AFM

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Silks and related biocomposite adhesive materials, as synthesised and used by a range of animals, are much studied. This is done in part to increase knowledge and understanding of their biological function, but also as a rich source of potential green materials to be harnessed biomimetically. Silkworm and spider silk protein polymers have dominated the latter research. But, increasingly a much broader range of animal silks are subject to detailed study. Glowworm silk, and the sticky glue biocomposite droplets it supports (fig.1), are of interest because of the high humidity environments in which the glowworm trap is deployed. In this study tapping mode atomic force microscopy (TM-AFM) was used to study the capture threads of glowworm (*Arachnocampa tasmaniensis*) to reveal nano-scale features, corresponding to variation in surface structure and elastic modulus, near the surface of the silk. Further, fast Fourier transform analysis of AFM phase angle images was used to contrast unstretched and stretched threads, to test for any systematic difference. Viscoelastic variation was resolved and revealed mostly globular and elongated features in the material. Results of this study demonstrate the practical usefulness of TM-AFM, especially phase angle imaging, in investigating the nano-scale structures that give rise to macro-scale function of soft and highly heterogeneous materials such as glowworm silk.

Fig.1 Vertically hanging *Arachnocampa tasmaniensis* silk threads. The sticky biocomposite droplets are about 2mm in length). A captured insect prey is also shown on the leftmost thread. Copyright: Bookend Trust/SIXTEEN LEGS. Photo credit: Joe Shemesh (Reproduced from [1]).

[1] D. Piorkowski, B.-C. He, S. J. Blamires, I.-M. Tso and D. M. Kane, *Molecules* **26**, 3500 (2021). https://doi.org/10.3390/molecules26123500