

The New Road to Silk: Bio-based Production of Silk-like Materials (Newsilk)



This project is addressing the challenge of how materials can be made in a sustainable way. Plastics that are used today are not sustainable in the long run, partly because of the raw material is fossil, and partly because too much of the plastics end up in the environment despite large efforts on recycling. To create a fully biological material that both can be made from bio-feedstock and does not accumulate in our environment, we work on silk as a material. Silk is made of protein which is a polymer. Plastics are also made of polymers, but on a molecular scale these different polymers behave very differently. In the NEWSILK project we combine polymer chemistry and biotechnical silk protein production to understand how silk protein polymers should be processed in order to form new materials such as fibers, adhesives, coatings, or composite structures. In the NEWSILK project we also work together with designers and artists to help communicate our work and to be part of the creative process in developing new concepts for material use when new processes and components open new ways to make materials.

The studies have been focused on understanding the factors that affect the assemblies formed by the proteins. This knowledge is vital in establishing the relationship between the processing conditions and material properties in order to fabricate products out from the proteins in a large scale. Prior to this project, the effect of various conditions affecting the self-assembly of these particular proteins were largely unknown and significant progress in field has already taken place during the project. The understanding has been supported by computational studies.

For example, a method to pull thread out of the protein solution (Figure) has been developed utilizing the fundamental understanding gained in the research.

In addition to the chemistry and biology, we have a multidisciplinary collaboration between disciplines where textile designers have been "visiting" in the field of synthetic biology, learning to work in the laboratory, pull the fibre and take microscope photos from the fibres. The designers have been inspired by synthetic biology, trying to imagine what these new designed and engineered materials mean for the future. The best term to describe this type of design research is design fiction, which is grounded in utopian design. Design fiction is a method that combines science facts and design, and even science fiction. The idea is to step outside your own discipline and tie design and science together using a creative narrative, with an aspect of what could be.

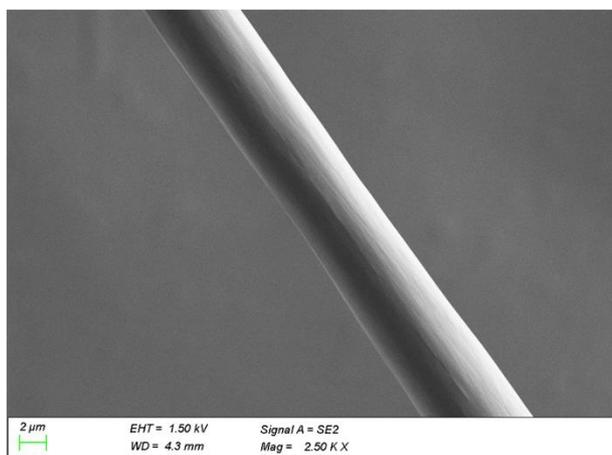


Figure. Electron microscopy image of a silk fiber made in this project.

We have been working on the utilization of silk across the scale from fundamental understanding to processing conditions and finally to textile designs. Significant advances have been made in all of the parts. We now work on combining the silk protein systems in new ways with for example cellulose.

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