

The role of processing on silk performance

Chris Holland

Dept. Materials Science and Engineering, The University of Sheffield, Sir Robert Hadfield Building, Mappin Street, Sheffield, S1 3JD. United Kingdom

Abstract

Silk has garnered significant attention over the past 20 years for biomaterial applications. However we are yet to truly develop the ability to process this material in a manner to retain all of its natural, and attractive, qualities. Silks are biological polymers that have evolved to be processed by controlled protein denaturation, a process depending on the researchers' background, with similarities to amyloidogenesis for some and flow induced crystallisation for others. Understanding the fundamental impact processing has on the performance of a silk will be the focus of this presentation.

Processing silk in the unspun liquid state has been largely explored over the past 15 years through the use of rheology. In this talk our contributions to this area will be presented and the tools that have been developed to probe structural hierarchies in silk as it self-assembles. Discussing more recent work we will draw on how whole animal and feedstock behaviour have supported new perspectives onto silk hydration, the natural spinning process, improved resolubilisation strategies and silk protein applications. We will conclude there is more to silk than just a fibre and that Nature may in fact hold unique solutions to the current challenges facing the synthetic polymer industry, i.e. routes towards low embodied energy, sustainable wet processing of polymers.

Biography

Dr Holland is a Senior Lecturer based in The University of Sheffield in the Materials Science and Engineering Department (www.naturalmaterialsgroup.com). He established the group through an EPSRC Early Career Fellowship after being previously at Oxford University in the Zoology Department where he undertook his degrees and Junior Research Fellowship. He has 50+ publications (H-index 23) and secured over £2M of direct research funding. He is a keen advocate of Science communication and outside the lab he is an Associate Editor for ACS Biomaterials Science and Engineering and Chair of the IoM3 Natural Materials Association.



His research uses tools developed for the physical sciences to better understand how processing effects performance in natural materials. Using silk as a model system and studying how it is spun, he has been able to gain unique insights into this material's biodiversity, structure and evolution. Additionally, this work has made important links between natural and industrial fibre processing which has led to several patents and a fundamentally new way of designing, testing and fabricating bio-inspired materials which is now being realised as part of the H2020 FET Open project FLIPT (www.h2020flipt.eu).