

International Webinar on Gels and Networks



Daniel R. King – Assistant Professor

*Hokkaido University, Sapporo, Japan
dking@sci.hokudai.ac.jp*

Scaling the Toughness of Soft Materials to New Heights through Fiber Reinforcement

ABSTRACT: The toughest of all materials found in nature consist of soft/hard composite structures. Examples include ligaments, which are made up of rigid collagen fibrils within a soft extracellular matrix, and nacre, consisting of ceramic plates bound together by a soft protein-based glue. In both cases, the soft/hard nature and hierarchical design results in these composites having mechanical properties that are significantly better than the neat components. With an aim to develop soft materials that have extraordinary toughness, we have fabricated soft/hard composites based on the reinforcement of soft yet extremely viscoelastic elastomers with woven fabrics.

To maximize energy dissipation, deformation must occur over a large area, and the components undergoing deformation must be extremely tough. To make robust, materials at small size-scale, fibers can be introduced to induce the fracture of matrix over an area much greater than the nominal crack path. Ultimately, we demonstrate that to make extremely tough fiber reinforced soft composites, three mechanical requirements exist: 1) A strong interface must exist between components, 2) the modulus of the fabric must exceed the modulus of the matrix by many orders of magnitude, and 3) the combined work to fracture of both components must be high. These criteria differ significantly from commercially utilized fiber reinforced polymers, and the materials introduced here represent the first case of all three requirements being achieved simultaneously.

GOALS:

- Understand the unique requirements that are necessary to create robust fiber reinforced soft composites
- Connect these relevant parameters to the mechanics of a tearing test
- Learn how we can use this understanding to optimize the toughness of soft composites for arbitrary length-scales

ABOUT THE WEBINAR:

Due to the ongoing global crisis involving COVID-19, there is little chance for the soft matter community to meet to learn about gels and networks. We propose this seminar as a way for members of the European and Asian communities to share our research and learn from each other, even when social distancing is necessary. The tone of this webinar is informal, and questions can be freely asked at any time. We welcome open discussion, and hope that all who attend will learn a lot!

Webinar website: <http://www.fp.a.u-tokyo.ac.jp/lab/sozai/seminar.html>

Registration:

<https://cnrs.zoom.us/meeting/register/tJlkd--gpjMoHdT0JuJ0fMqqUzx4isVNl5KZ>

Date: Thursday, September 9th, 2021

Time: 17:00-18:30 JST, 10:00-11:30 CET

Cost: Free

Organizers:

Daniel King (Hokkaido University)

Koichi Mayumi (University of Tokyo)

Tetsuo Yamaguchi (University of Tokyo)

Tetsuharu Narita (ESPCI Paris)