Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Fabrication of macroscopic composite hydrogels to increase fracture toughness RIKU TAKAHASHI, Graduate School of Life Science, Hokkaido University, Japan, DANIEL KING, TAKAYUKI NONOYAMA, TASUKU NAKAJIMA, TAOLIN SUN, TAKAYUKI KUROKAWA, JIAN PING GONG, Faculty of Advanced Life Science, Hokkaido University, Japan, OSAKA ORGANIC CHEMICAL INDUSTRY LTD. COLLABORATION — Hydrogels show characteristic properties such as high water content, high flexibility, permeability, low friction and so on. However, it is difficult to replicate the complex functions exhibited by biological materials with pure hydrogels. Therefore, we need to establish a novel approach to expand the properties of hydrogels. Recently, the development of hydrogel toughening methods enable us to fabricate more functional materials, such as composite materials. Typical examples of composite materials which are widely used are reinforced concrete, plywood, and fiber-reinforced plastics. These examples represent macroscopic composites, where the reinforcing phase consists of a macroscopic structure within a continuous matrix. When combined, the composite properties are superior to the properties of the individual components. Inspired by this concept, we try to fabricate macroscopic composite hydrogels using hydrogels as a soft matrix and a stiff reinforcing skeleton to increase mechanical properties. The resultant materials show high Young's modulus and high fracture toughness due to a multiple fracture process. We believe that these improved mechanical properties are caused by the combination of soft and brittle materials, similar to the effect seen in double-network hydrogels.

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Date submitted: 07 Nov 2016 Electronic form version 1.4