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The role of reinforcement geometry in toughening hydrogel composites[1] DANIEL KING, YIWAN HUANG, TAO LIN SUN, TAKAYUKI KUROKAWA, JIAN PING GONG, Hokkaido University — Reinforcing hydrogels with a stiff "skeleton" provides a method to create soft composites which possess mechanical properties desirable for biological applications, including high stiffness, flexibility, and shock absorption, all while containing water. Our recent research has shown that the energy dissipation of the composite is strongly dependent on the toughness of the matrix, when the failure mechanism is pullout of the fiber from the hydrogel matrix. Here we attempt to study the influence of composite toughness on the geometry of the fabric "skeleton" reinforcing the composite. We see that the size of the process zone is controlled by a balance between the tensile strength of the fibers and the frictional strength resisting pullout. If the strength of the fibers exceeds the frictional strength, failure by fiber pullout occurs. On the other hand, if the frictional strength exceeds the tensile strength of the fibers, fiber fracture occurs. Increasing sample width increases the frictional strength, and causes a composite failure transition from fiber pullout to fiber fracture. Based on this theory, we show that varying the reinforcement geometry influences the process zone size and therefore the toughness of the composite.

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