Super-Tough Hybrid Hydrogel Embedded with Mesoporous Silica for Controlled Release of Multiple Drugs

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As hydrogels can absorb a lot of water and maintain a three-dimensional structure and have biocompatible properties, they have been widely used in the various fields of bioapplications including tissue engineering, drug delivery system, immunotherapy, and regenerative medicine. But conventional hydrogels are easily ruptured by the external force. As one of methods to overcome this disadvantage, silica particles have been used as an additive material for improving mechanical properties of hydrogels. Here, we introduce the mesoporous silica-embedded hybrid hydrogels which have on-demand controlled release property and remarkably improved toughness by combining double-network and inorganic additive. The alginate/polyacrylamide hydrogel embedded with mesoporous silica showed a super-toughness due to diverse interactions including physical adherence, ionic crosslinking and covalent crosslinking between the components, and efficient energy dissipation through the multiple bonding. This super-tough hybrid hydrogel exhibited multi-drug loading and their sustained release profiles from hydrogel and mesoporous silica that is stimulated by an external mechanical force.