Fatigue-resistant, low hysteresis composite hydrogel sensor for monitoring signal

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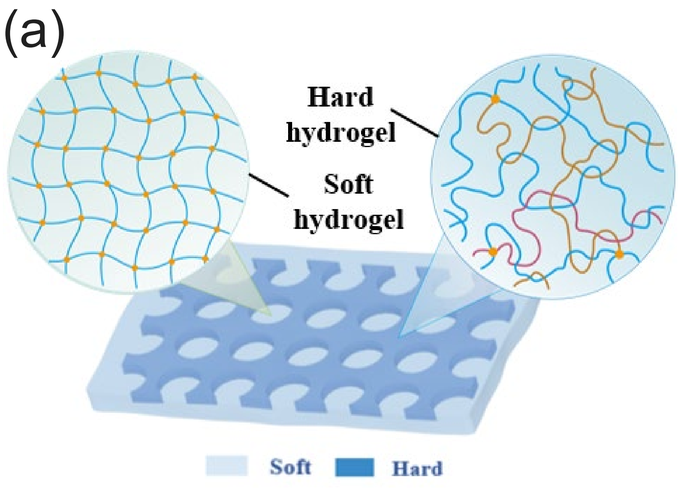
Introduction

Conductive hydrogels have attracted much attention due to their promising applications in flexible electronics, wearable devices. Under some dynamic load applications, conductive hydrogels are required to have certain mechanical properties and stable sensing capabilities. They are limited due to their poor mechanical properties and the incompatibility of hydrogels and conductive materials. Therefore, it is still challenging to develop conductive hydrogels with low hysteresis and fatigue resistance.

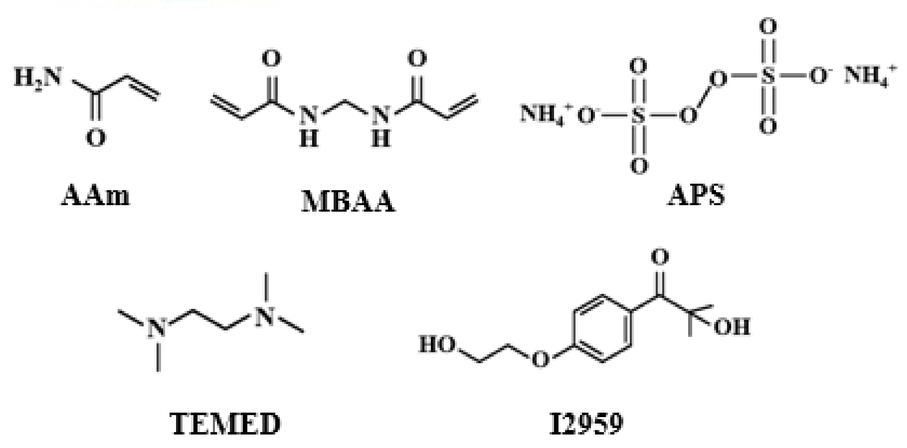
Methods

(a)



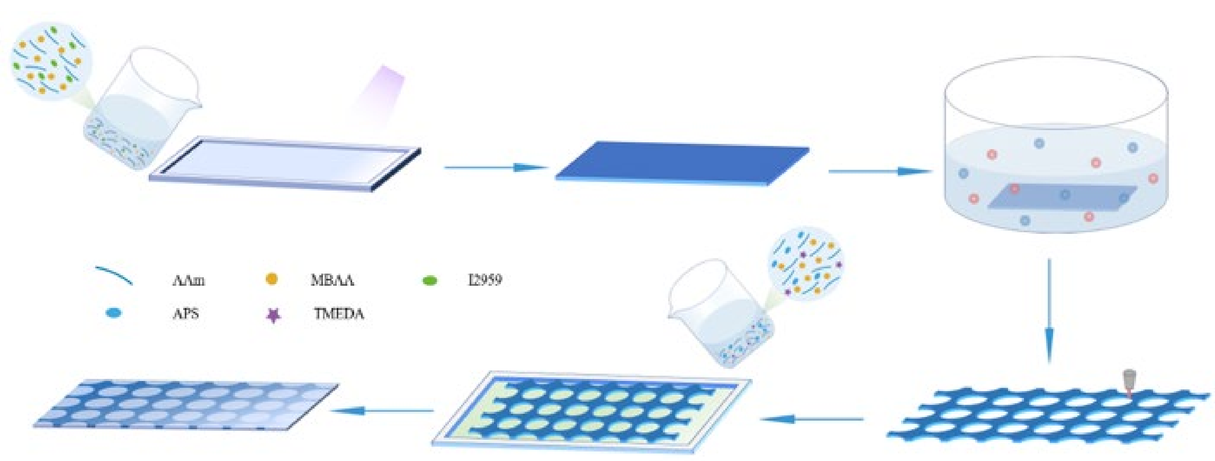
(a) Inspired by biological tissues, we fabricate a composite hydrogel strain sensor by combining soft and hard phases, which conducts by ions.

(b)



(b) Chemical structures of the components used to synthesize the composite hydrogel

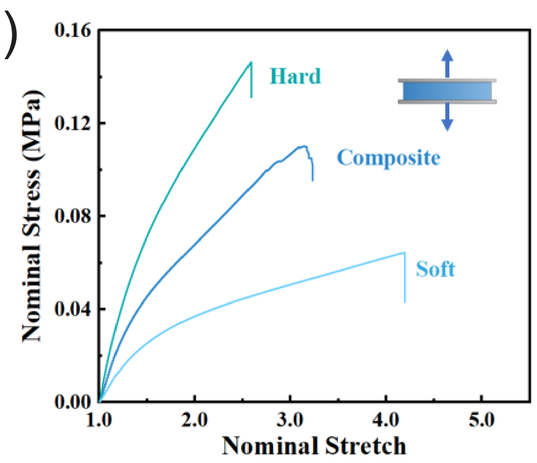
(c)



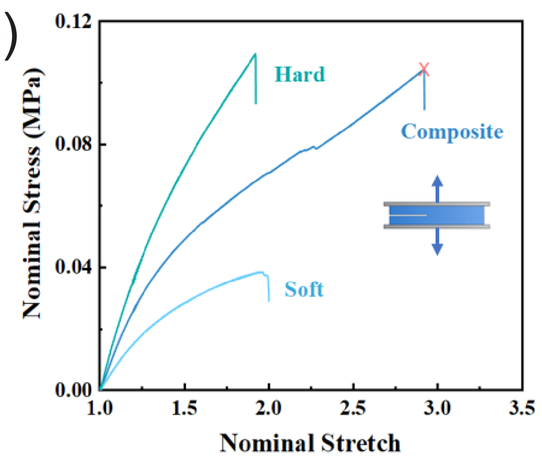
(c) Schematic illustration of the preparation process of the conductive composite hydrogel.

Discussion/Results

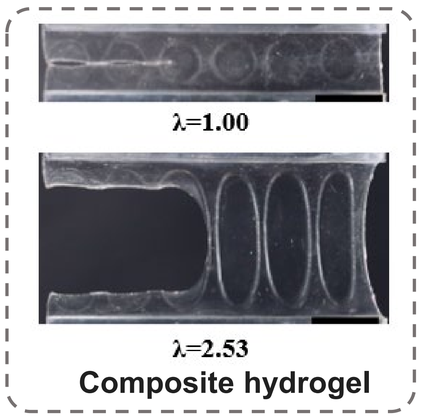
(a)



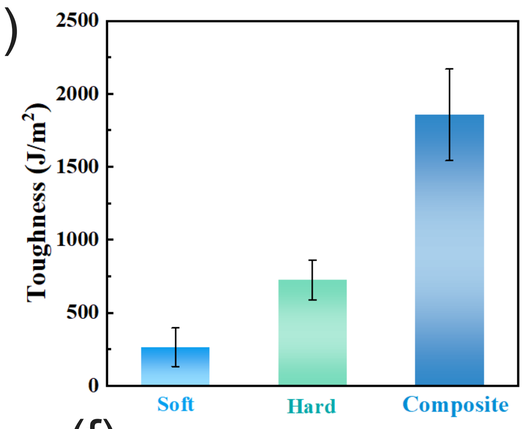
(b)



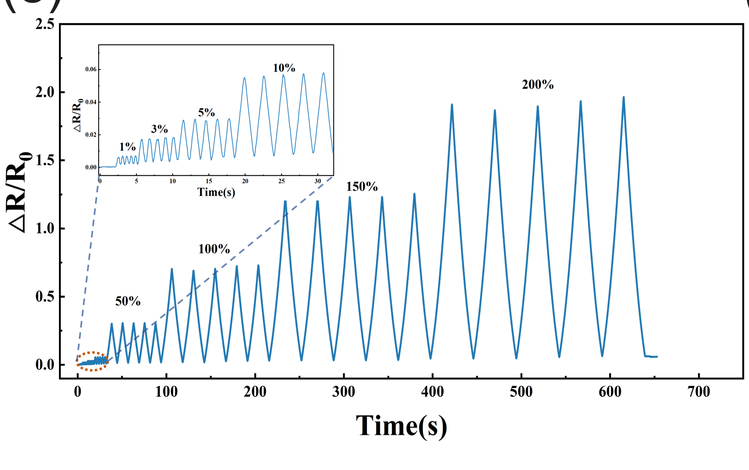
(c)



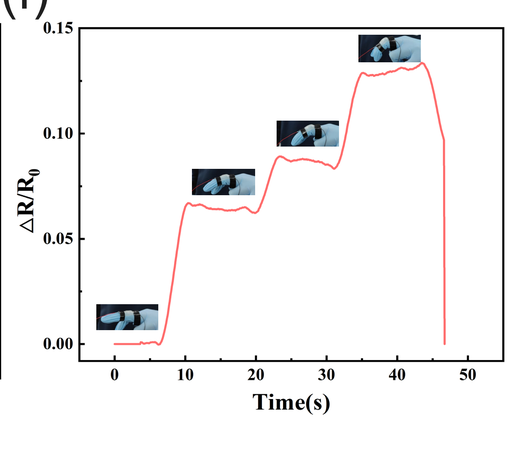
(d)



(e)



(f)



By analyzing the stress-stretch curves (a) and (b), the composite hydrogel sensor has high fracture-stretch ratio (c), toughness (d). Besides, it exhibits stable and reproducible sensing capability under small and large strains (e). This composite hydrogel strain sensor can be used to monitor different bending angles of fingers(f).

Conclusions

Inspired by biological tissues, we fabricate an ionically conductive composite hydrogel strain sensor by combining soft and hard phases. This composite hydrogel has a high fatigue threshold value of about 330J/m^2, and low hysteresis performance about less than 3%. This ion-conducting composite hydrogel with good mechanical properties and stable electrical conductivity shows great potential in the development of flexible electronic devices.