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Stretchable conductive adhesives with high electrical stability for wearable electronics

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Introduction

Epoxy-based conductive adhesives (ECAs)

have attracted attention as promising technologies for the next generation of smart wearable devices.

However, there have been technical issues to be solved

1) Due to their limited flexibility, cracks are easily formed.

2) During bending or stretching, they can detach from the substrates.

→ Thus, these issues significantly reduce the electrical conductivity.

As a result, the steady efforts have been made to fabricate *Stretchable conductive adhesive (SCA)* for next generation of smart wearable devices.

Purpose

We demonstrate stretchable conductive composites of high electrical conductivity and excellent adhesion to various flexible/or stretchable substrates, which has been achieved by reducing the Ag concentration in an elastomeric matrix with the aid of boron nitride (BN) as an auxiliary filler.

Experimentals

- **Fabrication process**

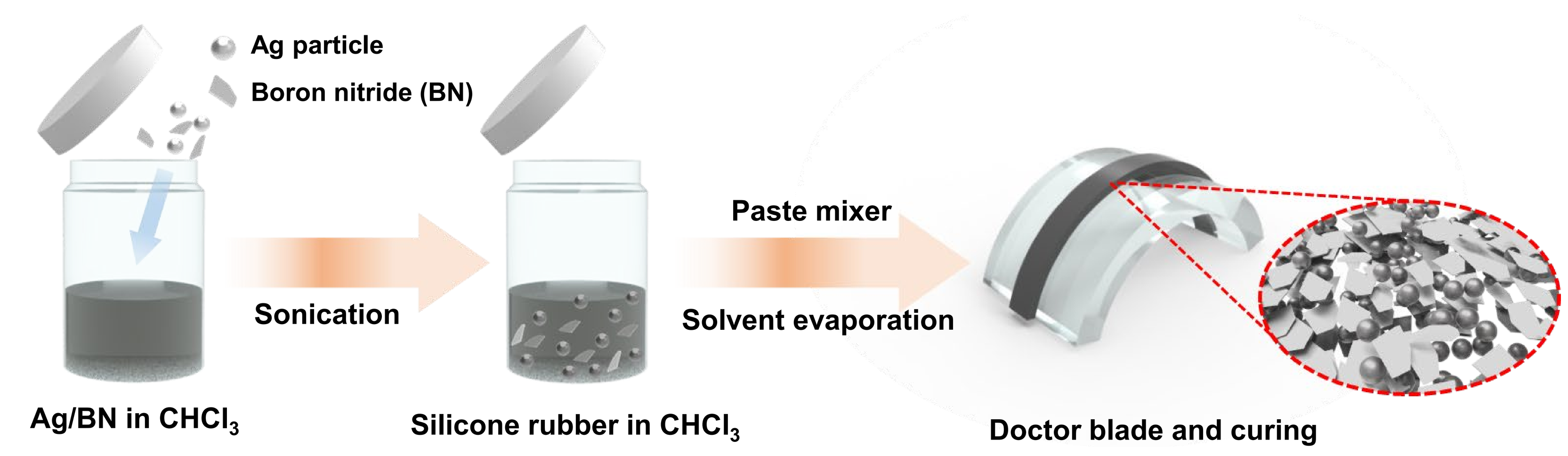

Fig. 1 Fabrication process of the stretchable conductive adhesives on various substrates

- **Sucrose-assistant process**

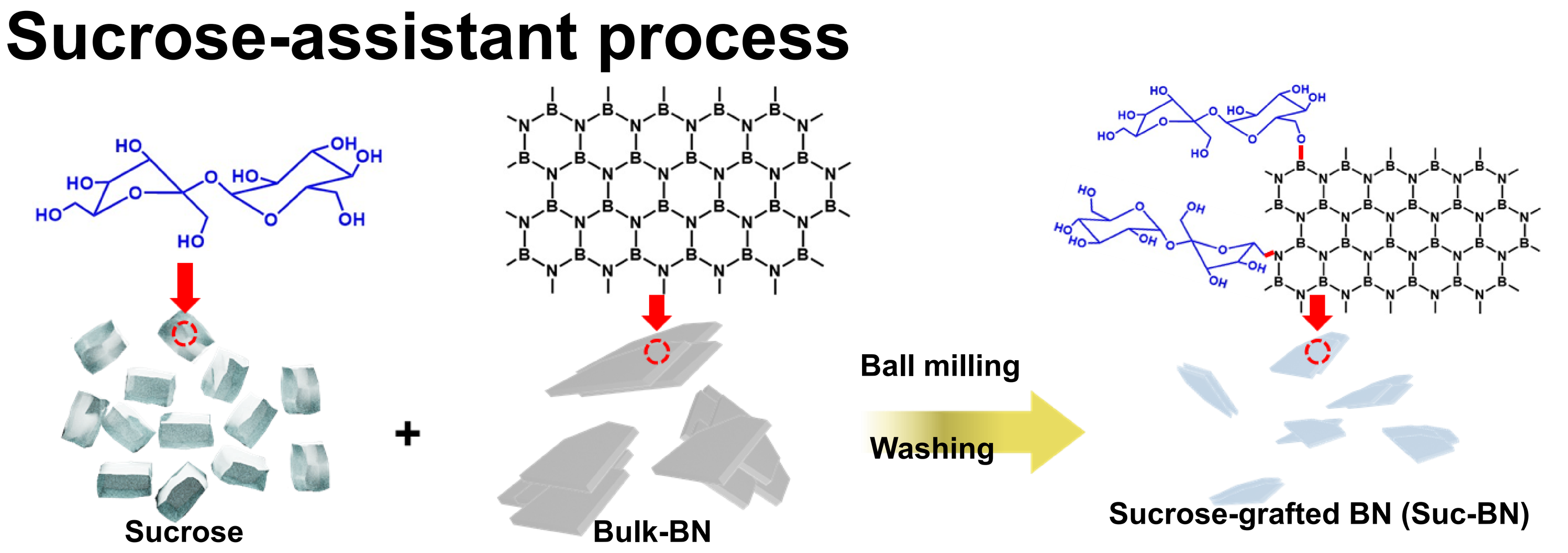

Fig. 2 Sucrose-assisted exfoliation of the pristine BNs

Electrical and morphological properties

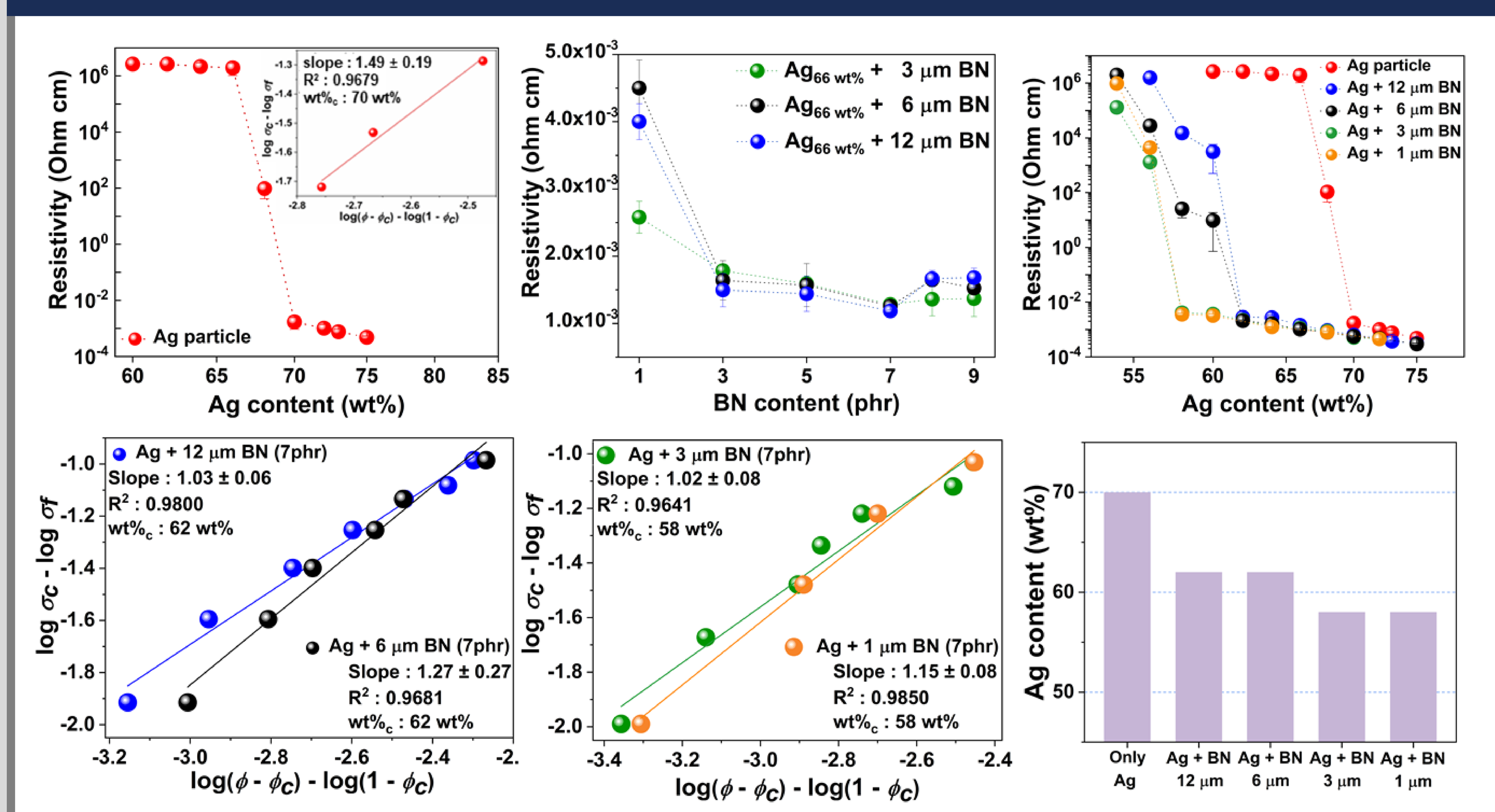

Fig. 3 Electrical resistivity of Ag/silicone adhesives with *h*-BN as a function of BN content

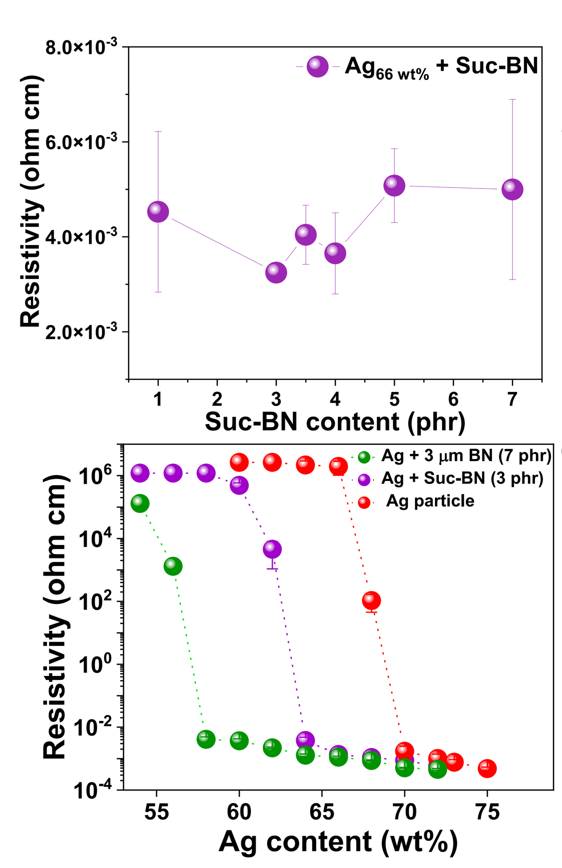

Fig. 4 Electrical resistivity of the Ag/silicone adhesives with suc-BN

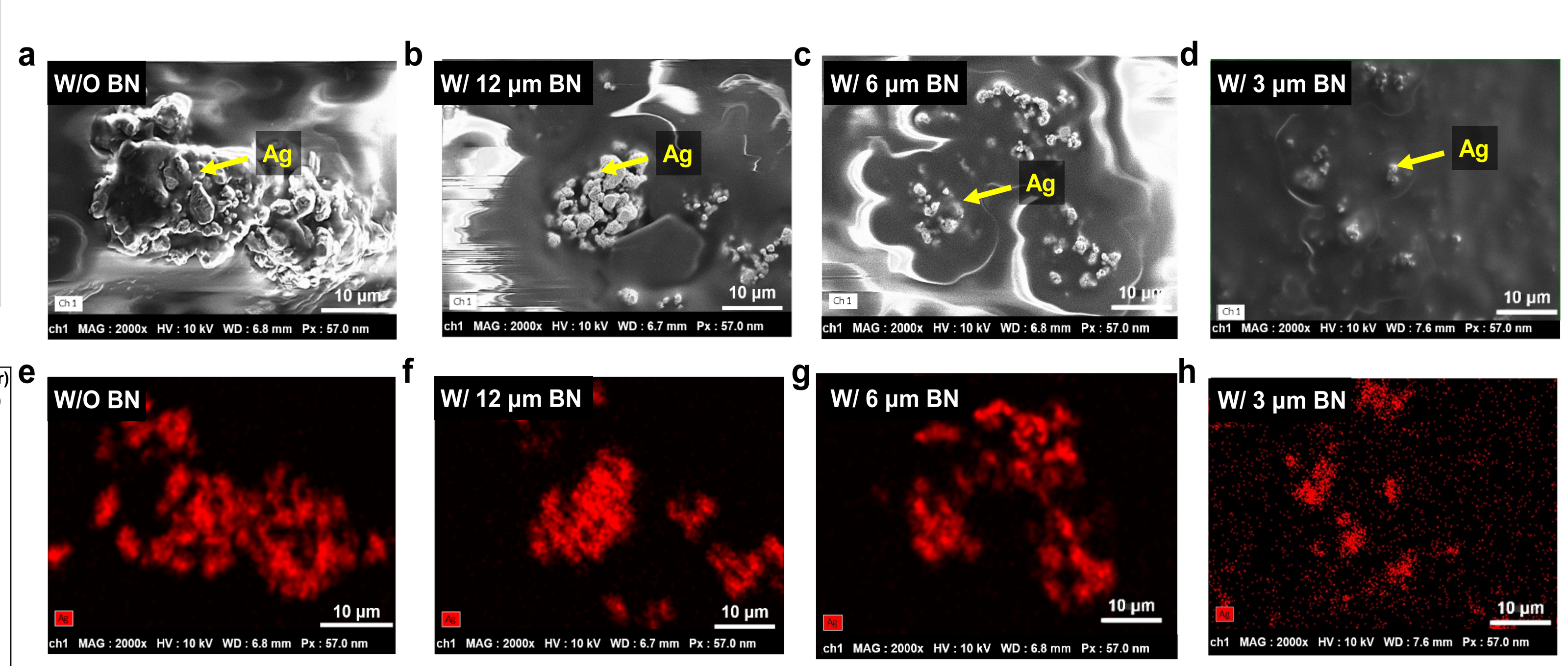

Fig. 5 SEM images and EDX Ag mapping of the Ag/silicone adhesives with/without BN

Mechanical properties and their applications

- Adhesion test

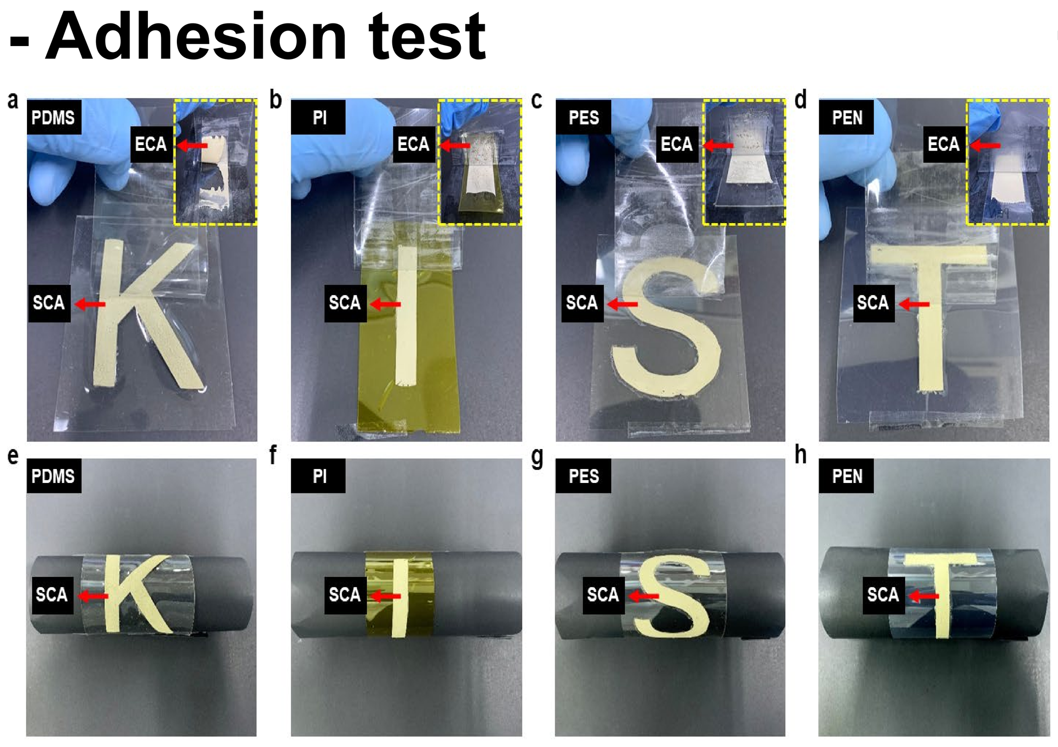

Fig. 6 Adhesion of the SCAs containing the 72 wt% Ag particles and 3 phr suc-BNs to various substrates

- Strain test

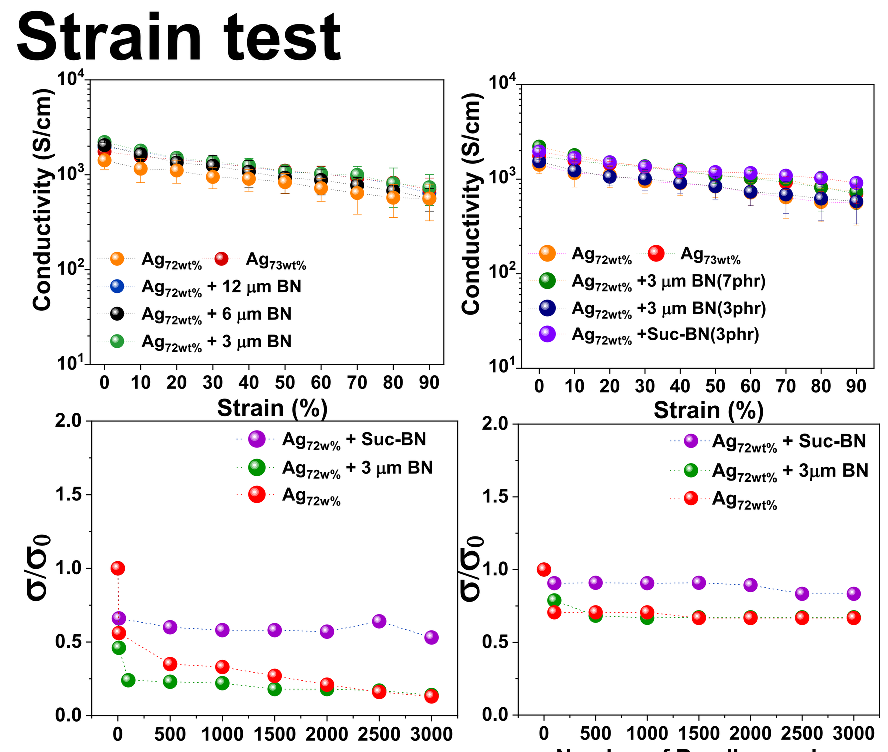

Fig. 7 Electrical conductivity of the Ag/silicone adhesives as a function of the strain

- Washing test

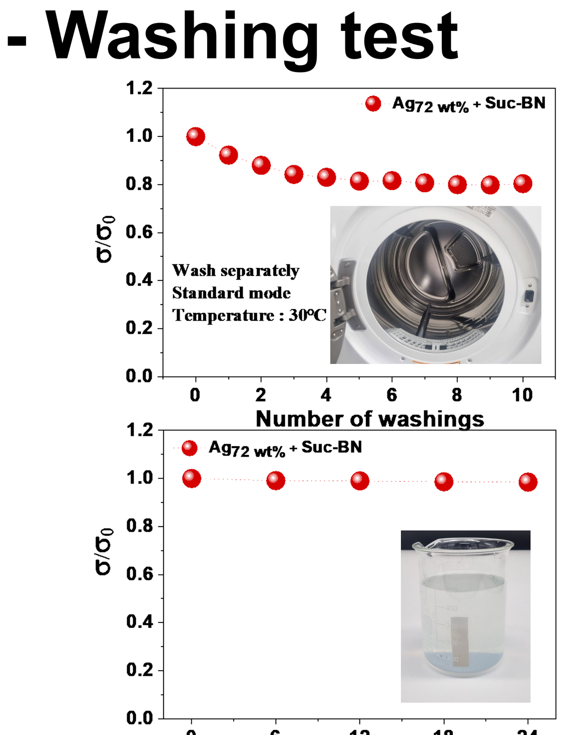

Fig. 8 After being immersed in detergent solution for 24 h and 10 repeated washings

- Demonstration of the SCAs

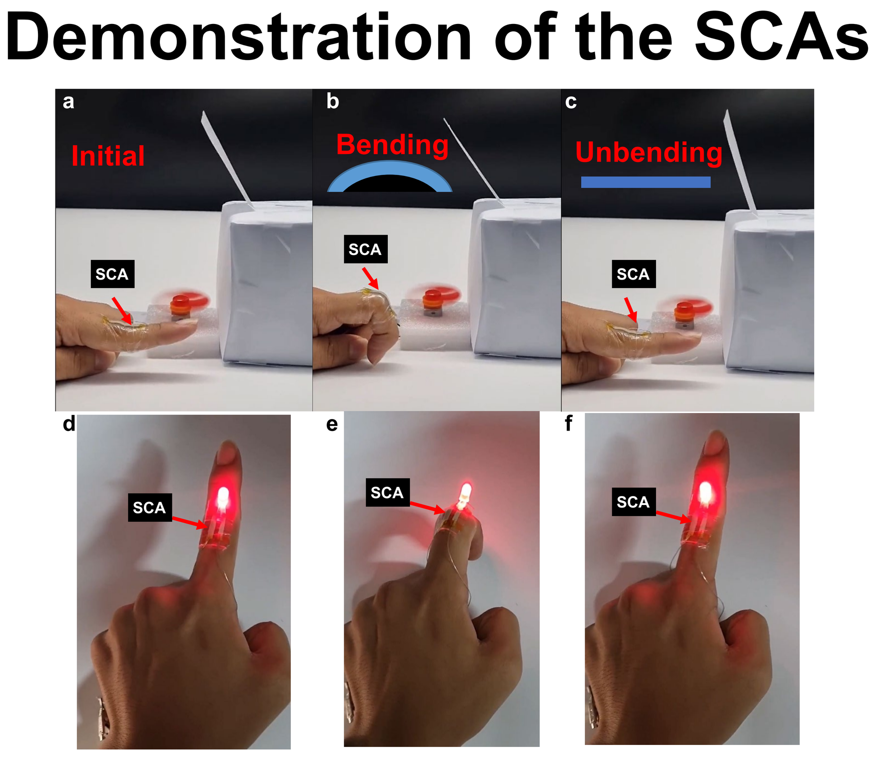

Fig. 9 SCAs interconnecting a battery with an electrical propeller (or a LED) on a human finger-joint

Conclusion

The rationally designed stretchable conductive adhesive (SCA) of high electrical conductivity and excellent adhesion has been achieved by reducing the Ag concentration with the aid of boron nitride (BN) as a non-conductive auxiliary filler in the composites. We believe that the strategy proposed in this study shows great potential for stretchable electronics, especially washable textile electronics.