Light Weight, Flame Resistance and Thermal Insulating MXene/Cross-Linked Collagen Fibers Composite Aerogel for Sensitive Pressure Sensor

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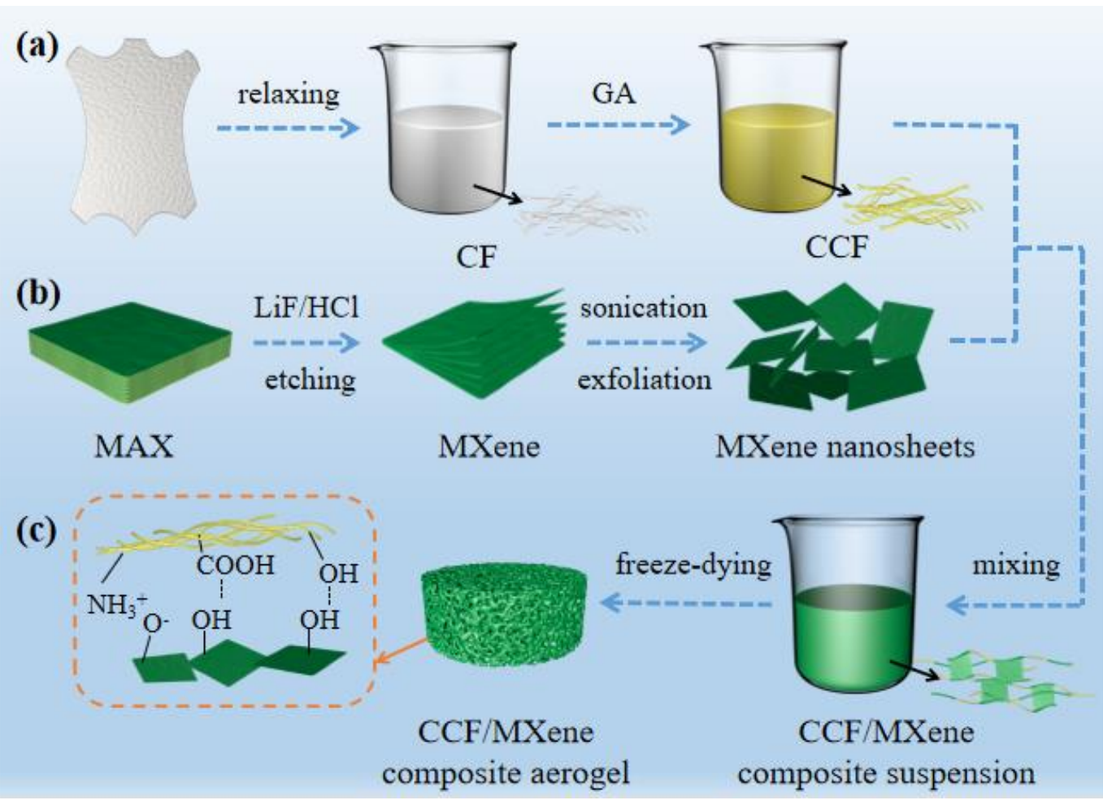
Introduction

In this work, cross-linked collagen fibers (CCF) was combined with MXene to obtain MXene/CCF composite aerogel. The 3D porous structure of MXene/CCF composite aerogel could improve the sensing performance. In addition, the MXene/CCF aerogel showed excellent flame resistance and thermal insulating property. This research provided a new thought for the high-value utilization of leather or CF, and could expand the application fields of leather.

Experimental



Results

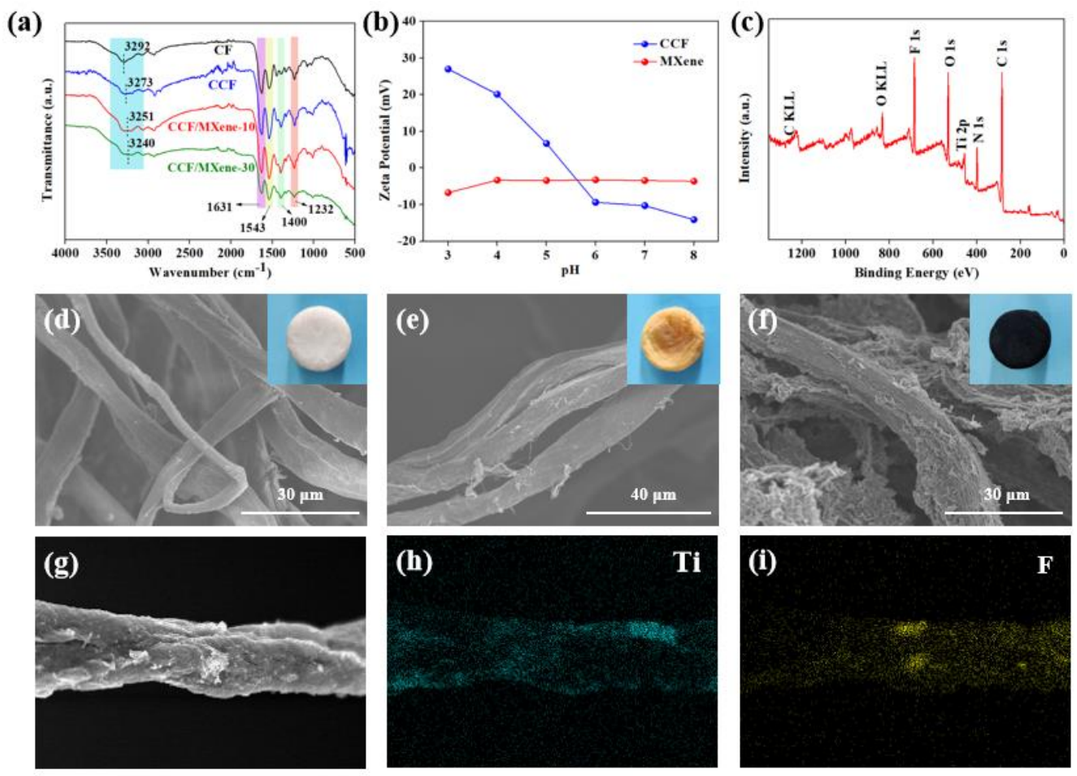


Fig. 1. (a) FTIR spectra of CF, CCF, CCF/MXene-10 and CCF/MXene-30 composite aerogels. (b) Zeta potentials of CCF and MXene. (c) XPS survey spectrum of the CCF/MXene composite aerogel. SEM images of (d) CF, (e) CCF, (f) CCF/MXene composite aerogel, and (g) fiber of CCF/MXene, (h) Ti and (i) F elemental mappings of CCF/MXene-50. The insets are optical pictures of aerogels.

There were hydrogen bonds and electrostatic force between MXene and CCF.

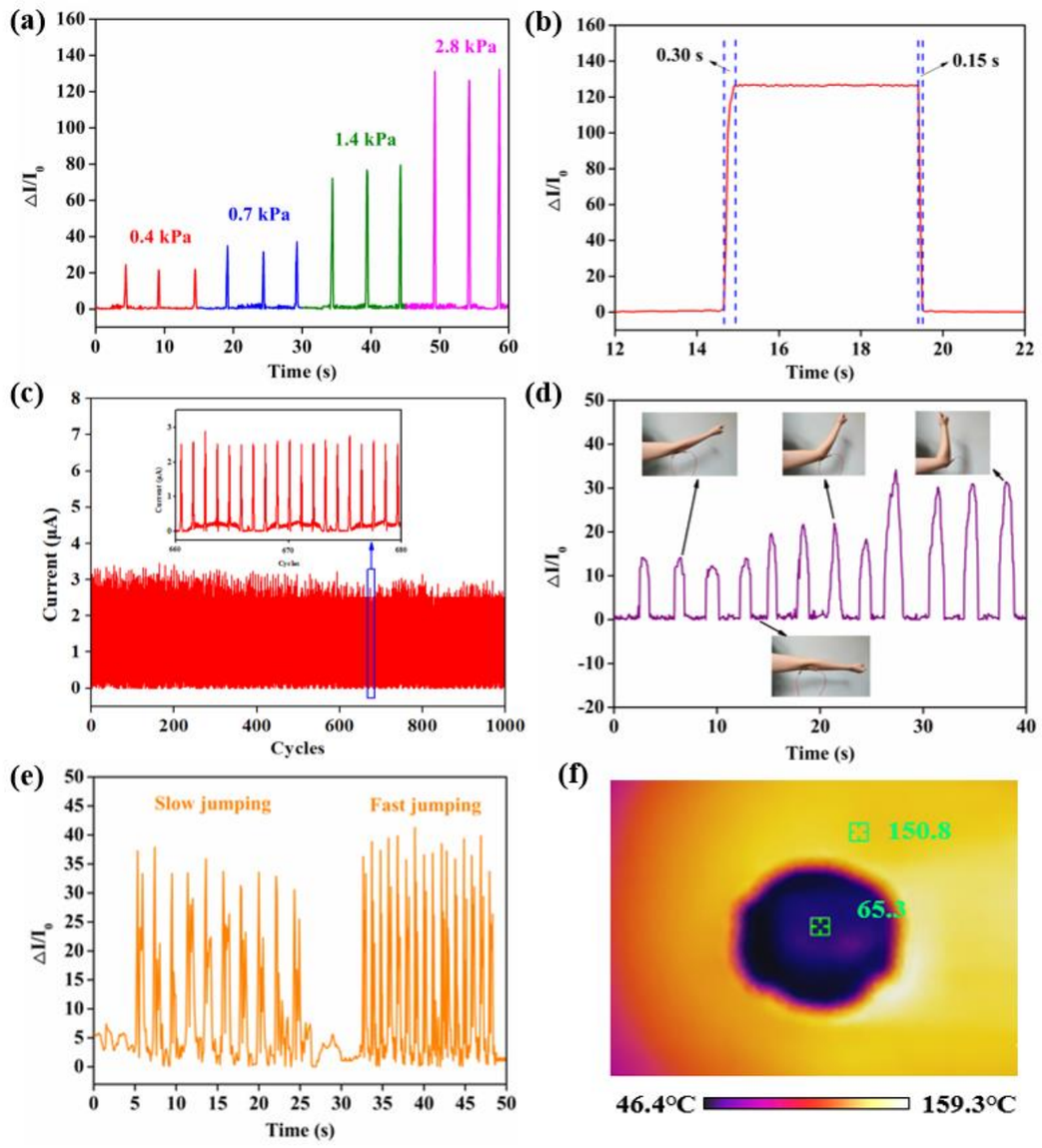


Fig.2 Piezoresistance properties of the CCF/MXene-50 composite aerogel. (a) I-T curve at different pressures. (b) Response and recovery time. (c) Sensing stability test of the CCF/MXene-50 composite aerogel. (d) Relative current variations of CCF/MXene-50 composite aerogel to detect human movements: (d) elbow bending, (e) jumping. (f) Infrared thermal image photos of the CCF/MXene-50 composite aerogel.

The MXene/CCF aerogel sensor showed a sensitive sensing property, good reproducibility, low detection limit (0.4 kPa), quick response time (300 ms), and recovery time (150 ms), which played a flexible role in detecting human movement. In addition, the MXene/CCF aerogel, as a multifunctional material, showed thermal insulating property.

Conclusion

- The CCF/MXene composite aerogel with the demonstrated sensing performance, excellent thermal resistance, were prepared by blending-casting and freeze-drying.
- The CCF/MXene composite aerogel consist of a porous 3D structure with well-controlled interface between CCF and MXene, which provides sufficient mechanical strength to support the applied pressure.
- With the unique sensing performance, the CCF/MXene composite aerogel promise broad application prospects in human movement monitoring.

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