Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting information

Written 3D-conductive Pathway in Leather for Highly Sensitive and Durable electronic whisker

Ruijie Xie,†[a] Jingyu Zhu,†[a] Haibo Wu,†[a] Kang Zhang,[a] Binghua Zou[a] Xueyan Zhang,[a] Jiayuan Liang,[a] Bing Zheng,[a] Sheng Li,[a] Weina Zhang,[a] Weihuang,[a,b] Jiansheng Wu[a]* and Fengwei Huo[a]**

[a]Key Laboratory of Flexible Electronics (KLOFE) & Institute of Advanced Materials (IAM), Nanjing Tech University (NanjingTech), 30 South Puzhu Road, Nanjing 211816, P.R. China

[b] Shaanxi Institute of Flexible Electronics (SIFE), Northwestern Polytechnical University (NPU), 127 West Youyi Road, Xi'an 710072, P. R. China.

Corresponding author

*E-mail: iamfwhuo@njtech.edu.cn

*E-mail: iamjswu@njtech.edu.cn

*E-mail: iamwhuang@nwpu.edu.cn

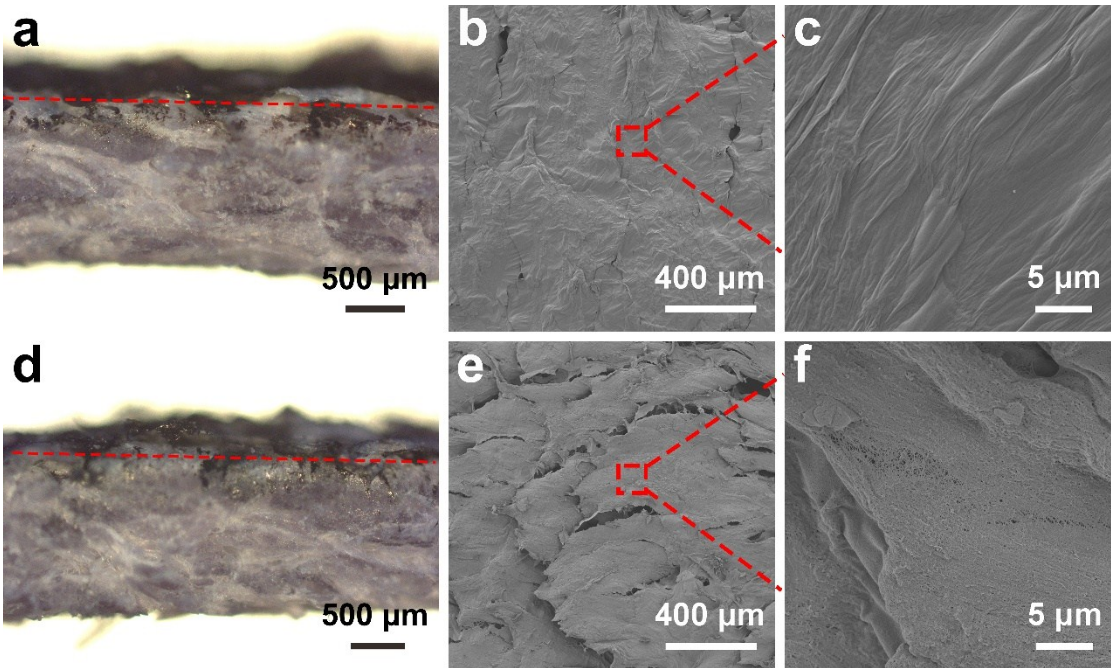

Figure S1 a, d) Photographs of cross section of leather covered by GO (a) and SWCNT (d) respectively. b-c, e-f) SEM images of surface of leather covered by GO and SWCNT respectively.

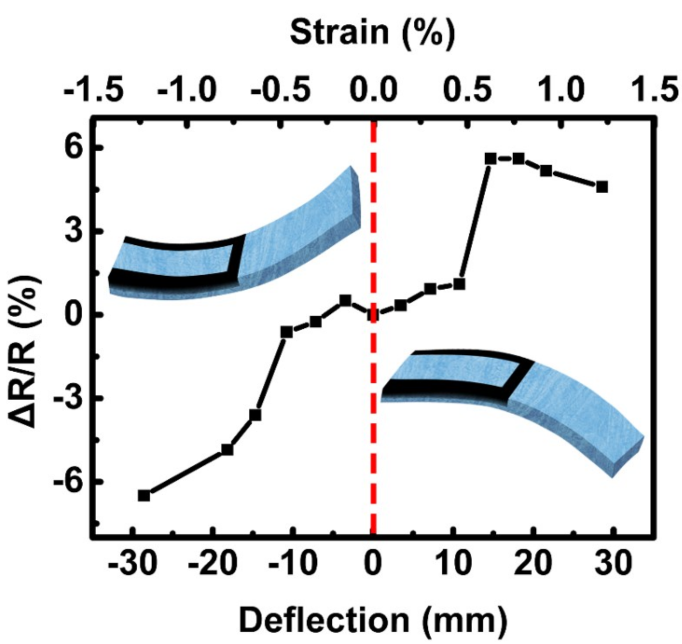

Figure S2 Relative change of resistance of leather-based e-whisker assembled by SWCNT under different strains.

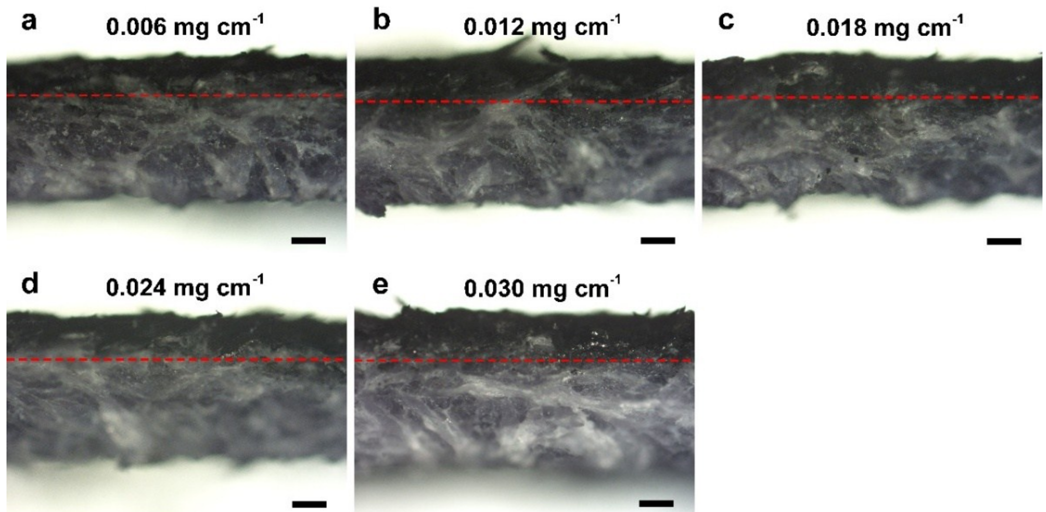

Figure S3 Photographs of cross section of leather covered by different loadings of CB: a) 0.006 mg cm^{-1}; b) 0.012 mg cm^{-1}; c) 0.018 mg cm^{-1}; d) 0.024 mg cm^{-1}; e) 0.030 mg cm^{-1}. Scale bars in a-e: 200 μm.

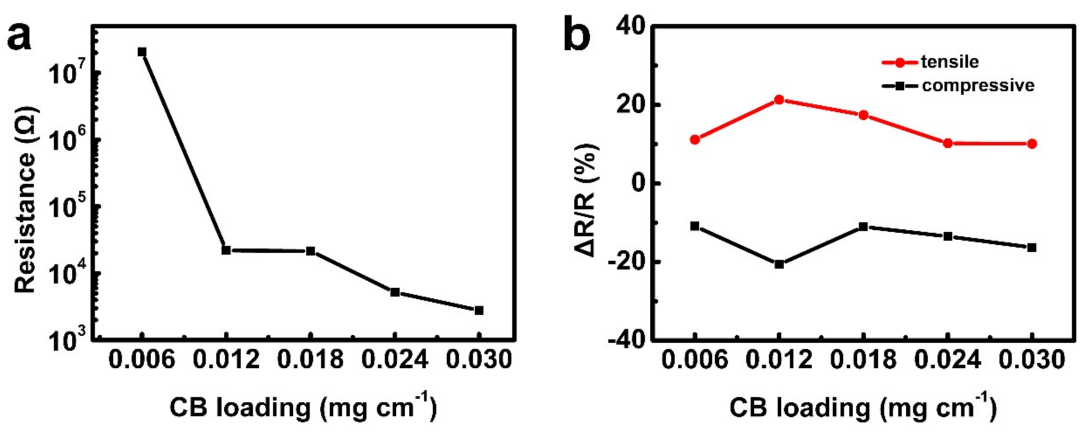

Figure S4 a) Resistance of the leather-based e-whisker depending on the load of carbon black. b) Relative change of resistance of the leather-based e-whisker with different loadings of CB for the same deflection.

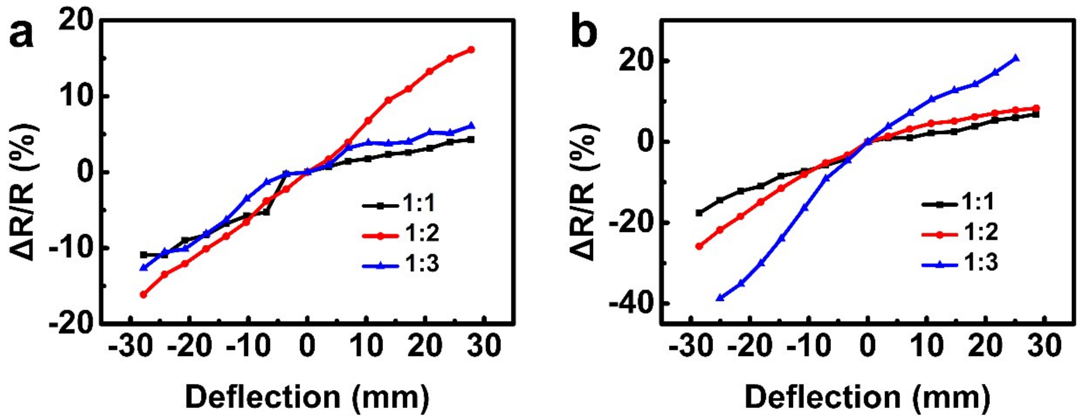

Figure S5 a) Electrical signals response to different deflections for leather-based e-whiskers various in the length of conductive patterns. b) Electrical signals response to different deflections for leather-based e-whiskers with different length.

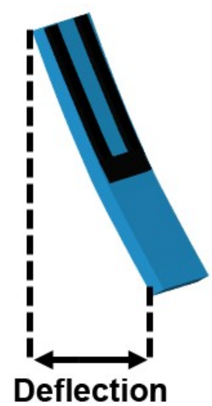

Figure S6 The definition of deflection.

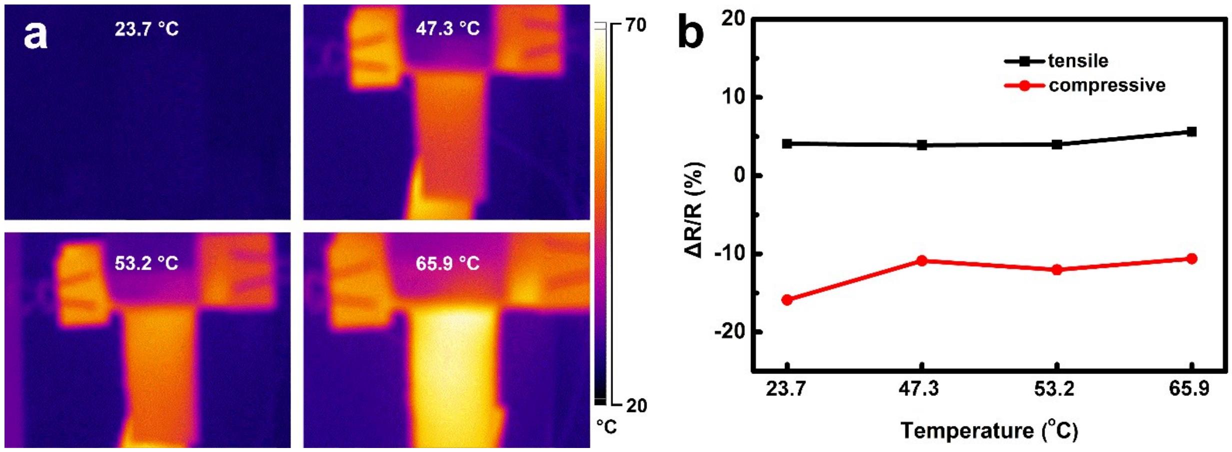

Figure S7 a) Distribution of different temperatures on surface of leather-based e-whisker. b) Performance of leather-based e-whisker under different temperatures.

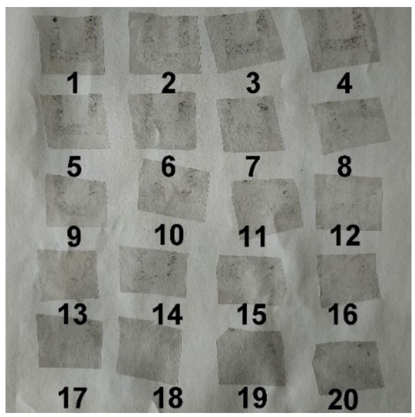

Figure S8 Tapes after each peel test.

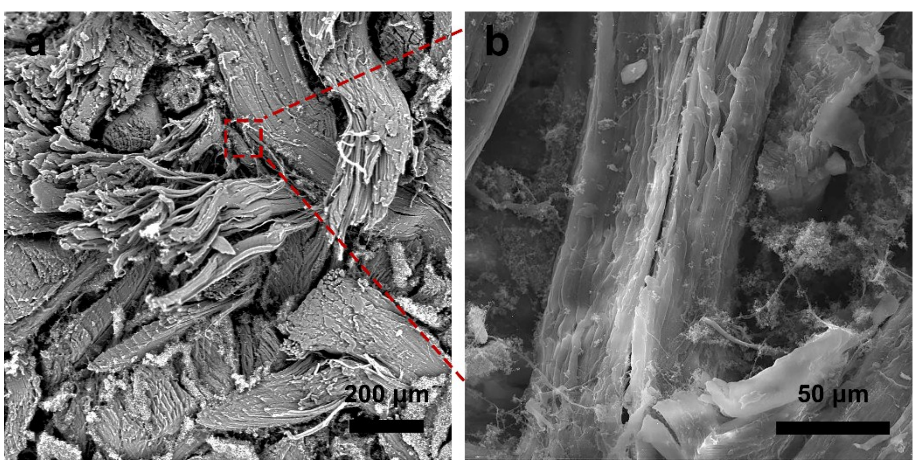

Figure S9 a-b) SEM images of surface of leather-based e-whisker after the tape testing.

Figure S10 Photograph of the process to test leather-based e-whisker's abrasion durability.

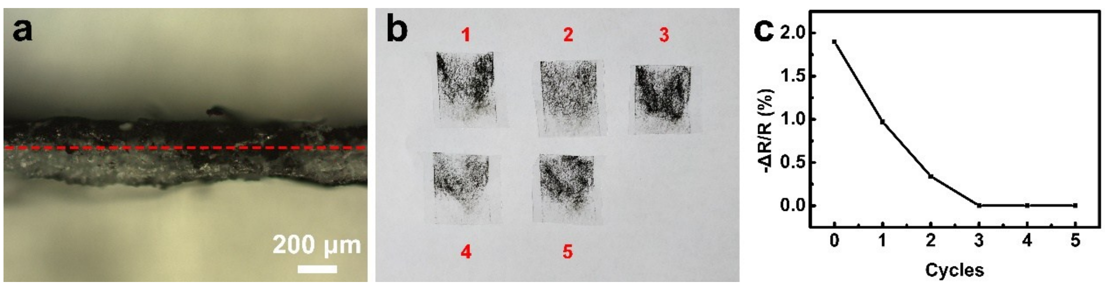

Figure S11 a) Photograph of cross section of paper-based e-whisker. b) Tapes after each peel test for paper-based e-whisker. c) Performances of paper-based e-whisker after each tape test cycle.

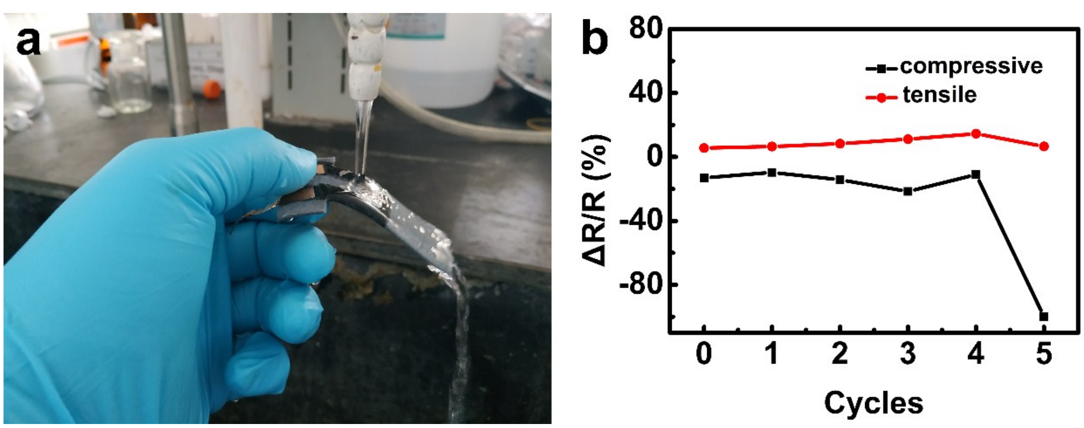

Figure S12 a) Photograph of the process to test leather-based e-whisker's washing durability. b) Performances of leather-based e-whisker after each washing cycle.

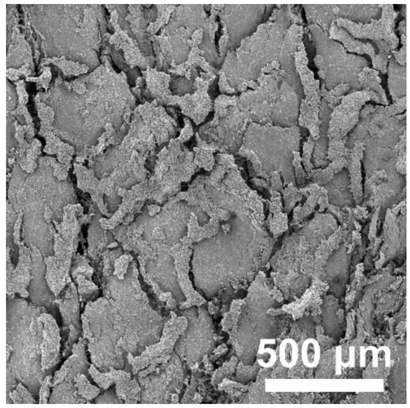

Figure S13 SEM image of leather-based e-whisker after be washed for 25 min.

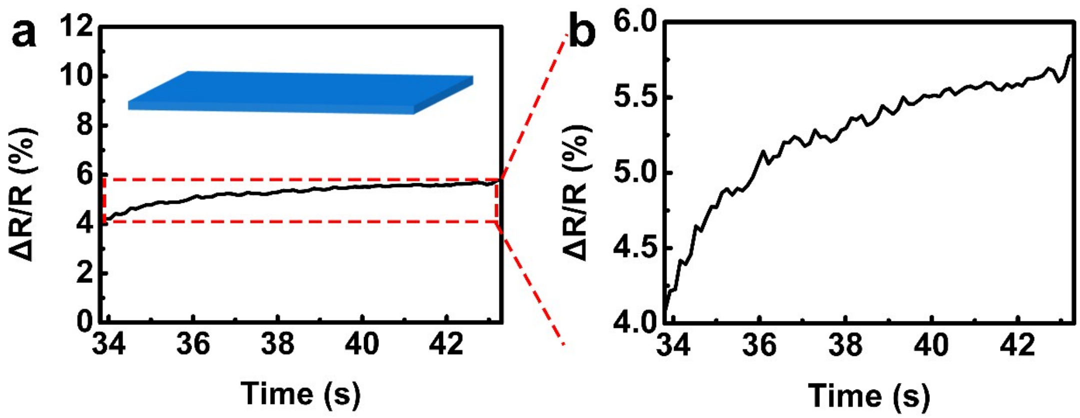

Figure S14 a-b) Baseline (a) and background signal of leather-based e-whisker when it scanning the surface of glass.

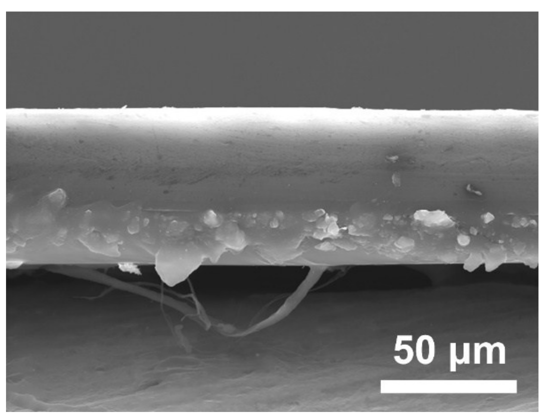

Figure S15 SEM image of cross section of tape.

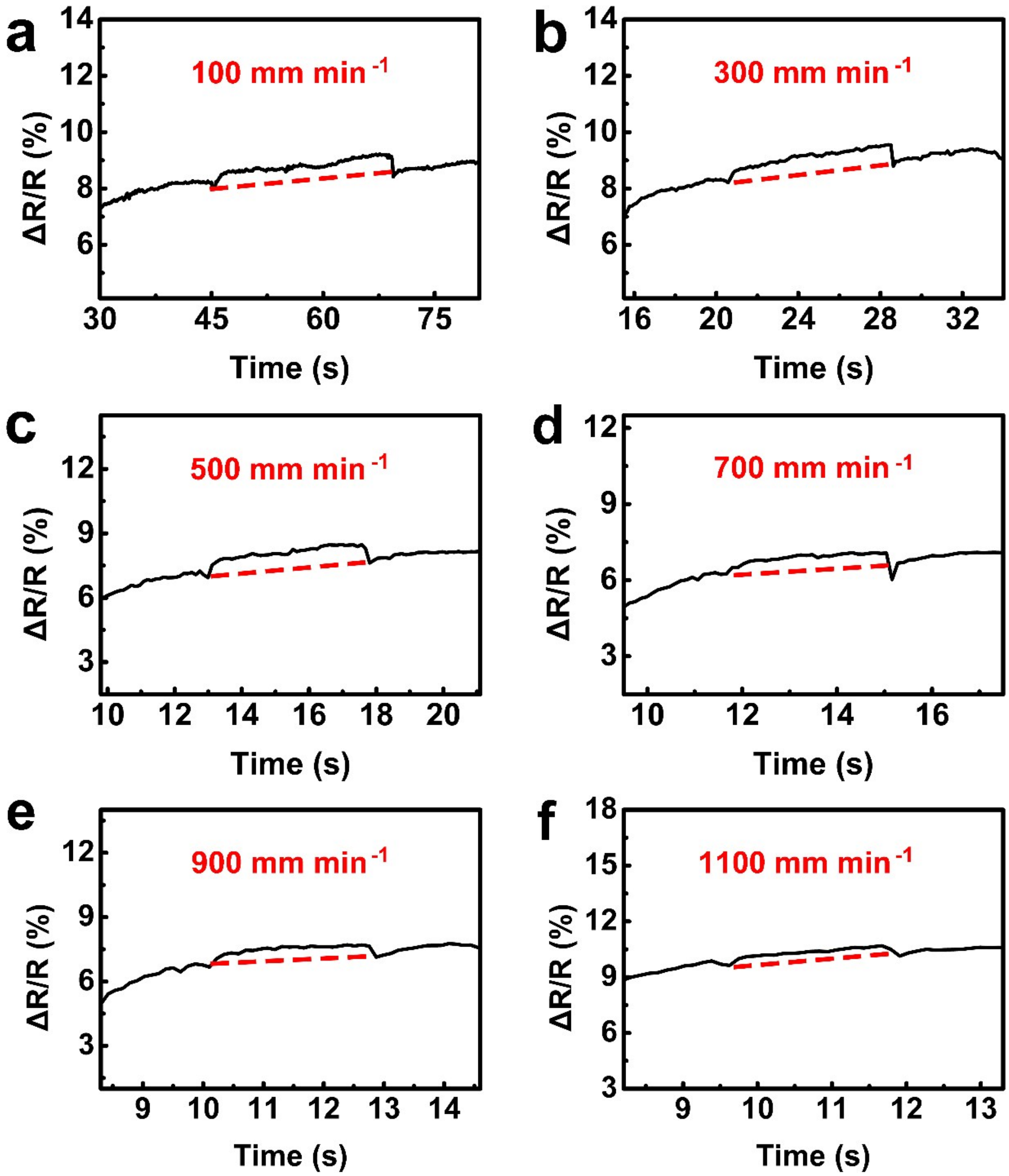

Figure S16 Electrical signals of leather-based e-whisker respond to a height change of 50 μm at different scanning speeds: 100 mm min^{-1} (a), 300 mm min^{-1} (b), 500 mm min^{-1} (c), 700 mm min^{-1} (d), 900 mm min^{-1} (e), and 1100 mm min^{-1} (f).

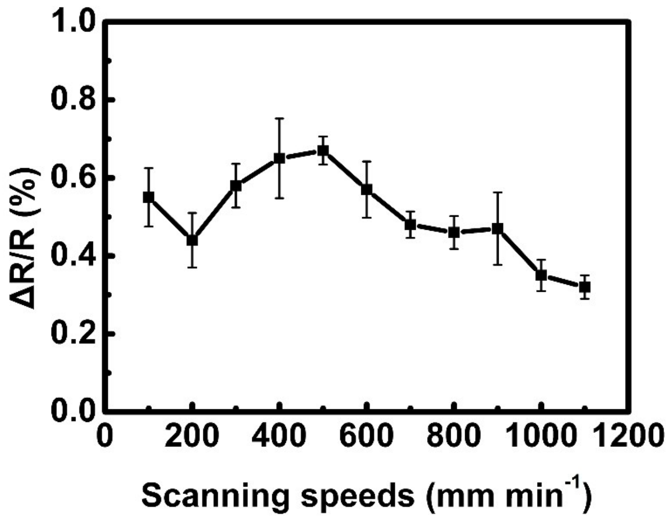

Figure S17 ΔR/R of leather-based e-whisker respond to a height change of 50 μm at different scanning speeds.

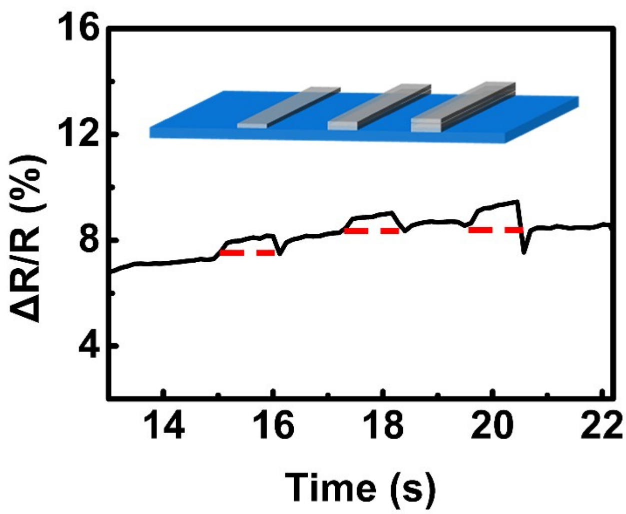

Figure S18 Detection of surface that possess embossments with various height (50 μm, 100 μm, and 150 μm).

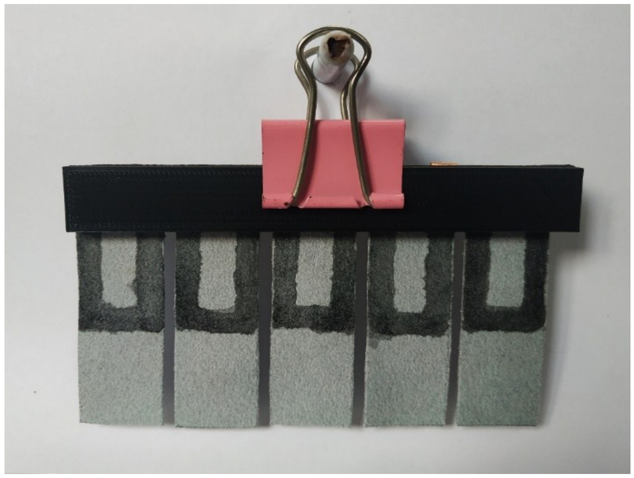

Figure S19 Photograph of leather-based e-whisker array.

Table S1 Comparation between leather-based e-whisker and other e-whiskers

Reference	Substrates	Fabrication methods	Minimum detection height difference	Linearity	Durability
16	PDMS	Painting	No reported	Linear	Poor
27	Silicone, PET and PE	Screen printing	200 μm	Nonlinear	Poor
29	Paper	Writing	No reported	Two linear regions	Poor
37	Polyurethane	3D-printing	No reported	Linear	Good
This work	Leather	Writing	50 μm	Two linear regions	Good