Supporting Information

Cu–Ag core–shell nanowires for electronic skin with a petal molded microstructure

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Experimental Section

Preparation of CuNWs and Cu-Ag core-shell NWs films: The bulky CuNWs film and Cu-Ag core-shell nanowires film (about 120 $mg \cdot m^{-2}$) were formed by the vacuum filtration method without adding any polymer. The electrical resistance was immediately measured after the bulky film dried in vacuum oven at 50 ºC for 1.0 h.

Preparation of PDMS/CuNWs conductor: The PDMS/CuNWs conductor was fabricated according to Ref. 1. Typically, CuNWs was dropped on a glass slide (about 120 $mg \cdot m^{-2}$) and dried in vacuum oven at 50 ºC for 1.0 h. After that, liquid PDMS was immediately poured onto the CuNWs film, the liquid PDMS will penetrate into the CuNWs network due to its low viscosity and low surface energy. Then the PDMS was cured at 100 ºC for 1 h and peeled off, highly cross-linked PDMS with CuNWs embedded on surface was obtained.

Table S1 Property comparison of copper, silver and gold.

Property	**Copper**	**Silver**	**Gold**
Resistivity	$1.78\times10^{-6}\ \Omega\cdot cm$	$1.65\times10^{-6}\ \Omega\cdot cm$	$2.05\times10^{-6}\ \Omega\cdot cm$
Content in earth	0.01%	0.00001%	0.0000001%
Price	\$ 5.941/g for CuNWs	\$ 32.590/g for AgNWs [1]	\$ 1365.298/g for AuNWs
	\$ 6.4/kg for bulk copper	\$ 517.1/kg for bulk silver	\$ 37000/kg for bulk gold
Thermal conductivity	400 W/m·K	429 W/m·K	318 W/m·K
Oxidative stability	**Very poor**	**Excellent**	**Excellent**

Calculation of the price of AuNWs

According to the Ref.2, 44 mg chloroauric acid ($HAuCl_4\cdot3H_2O$), 1.5 mL oleylamine (OA) and 2.1 mL triisopropylsilane (TIPS) were required to synthesis gold nanowires (AuNWs). The price of $HAuCl_4\cdot3H_2O$, OA and TIPS are \$ 80.5/g, \$ 0.65/mL and \$ 4.5/mL (The price of the reactants were taken from Aladdin), if the productivity of AuNWs is 100% and the price of solvent to wash the AuNWs is not taken into consideration, the price of AuNWs is about \$ 1365.298/g.

Table S2 Summary of core-shell nanowires based on CuNWs reported up to now.

Core	**Shell**	**Method**	**Applications**	**Reference**
CuNWs	Ni	One pot method at 180 ºC	Flexible conductor	3
CuNWs	Pt	Electrodeposition method	Transparent electrode	4
CuNWs	Zn	Electrodeposition method	Transparent electrode	5
	Sn	Electrodeposition method	Transparent electrode	
CuNWs	Ni	One pot method at 210 ºC	Tunable optic and magnetic properties	6
	Au			
CuNWs	Pt	Galvanic displacement	Oxygen Reduction Electrocatalysts	7
CuNWs	Au	Electrodeposition method	DNA detection	8
CuNWs	Ni	One pot method at 210 ºC	Potential application in microelectronics and magnetic recyclable catalysis.	9
CuNWs	Ag	Two step method (Ag-amine reagent solution)	Conductive Fillers for LDPE	10
CuNWs	Ag	Replacement reaction with citric acid and PVP	Not provided	11
CuNWs	Ni	Electroplate	Transparent electrode	12
CuNWs	CNTs	Self-Scrolling	Building blocks for novel functional materials	13
CuNFs	AZO	Electrospinning and reduction	Transparent Electrode	14
CuNWs	C	CVD followed by thermal decomposition	Electronic transport and thermal conductivity	15,16
CuNWs	ODA	Hydrothermal treatment	Conductive Fillers for PS	17
CuNWs	FeCo	Electrodeposition method	Control delivery of drugs or macromolecules	18
CuNWs	Graphene	PVD at 650 °C	Electrical and thermal conductivity enhancement	19
CuNWs	**Ag**	**Galvanic displacement at room temperature without any stirring or dispersant**	**Flexible E-skin**	**This work**

***Abbreviations*:** CuNFs, copper nanofibers; AZO, aluminum-doped zinc oxide; ODA, octadecylamine; CVD, chemical vapor deposition; PVD, physical vapor deposition; LDPE, low density polyethylene； DNA, deoxyribonucleic acid; PS, polystyrene.

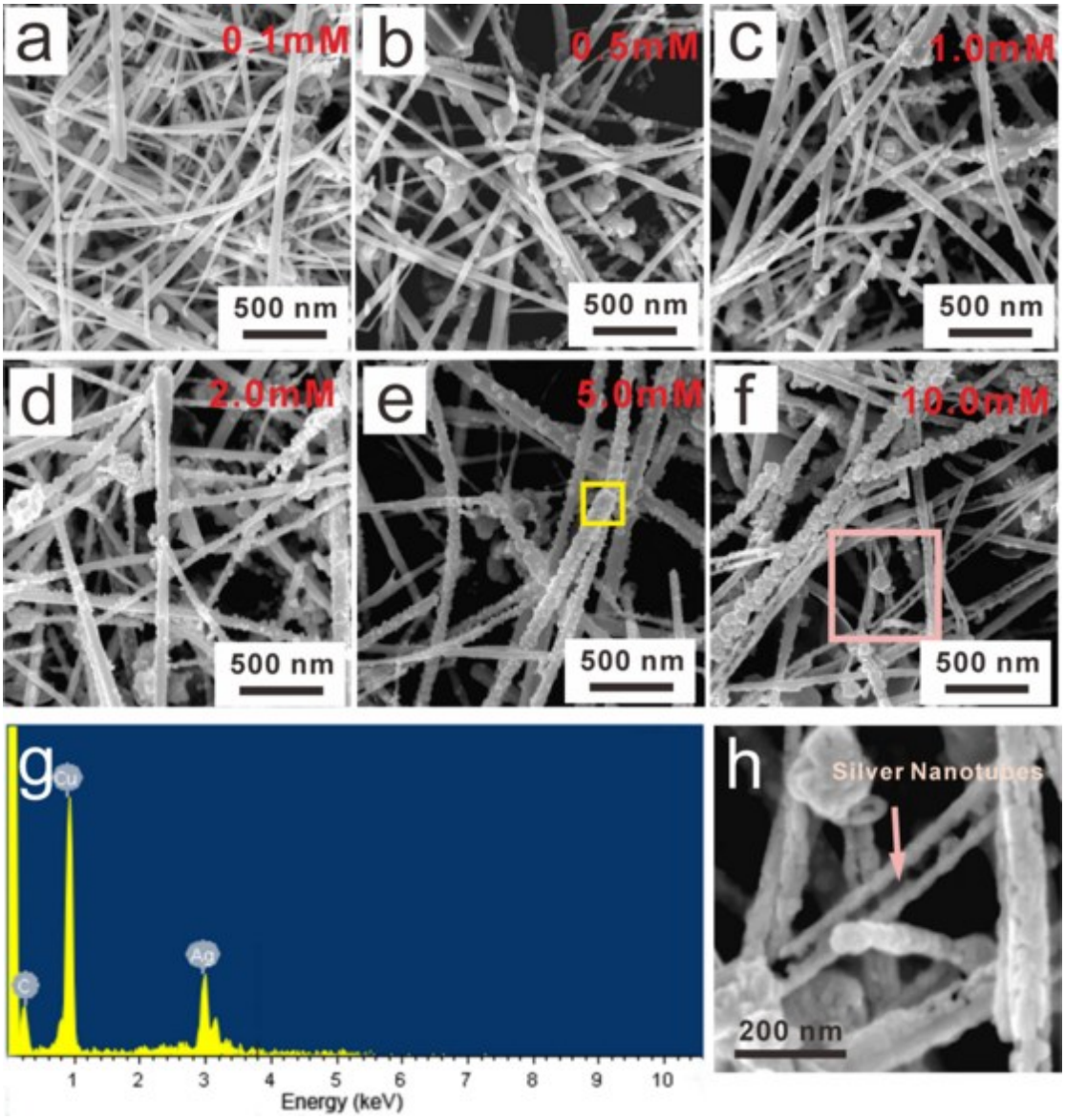

Fig.S1 Formation of Cu-Ag alloyed structure through galvanic replacement reaction between CuNWs and $AgNO_3$ solution. FESEM images were taken after reacting 2.0 mL 5 $mg \cdot mL^{-1}$ CuNWs suspension with 100 mL of (a) 0.1 mM, (b) 0.5 mM, (c) 1.0 mM, (d) 2.0 mM, (e) 5.0 mM and (f) 10.0 mM $AgNO_3$ solution for 30 min. (g) is the EDAX spectrum of selected area in Fig.3e and (h) is the higher magnification of the selected area in Fig.3f.

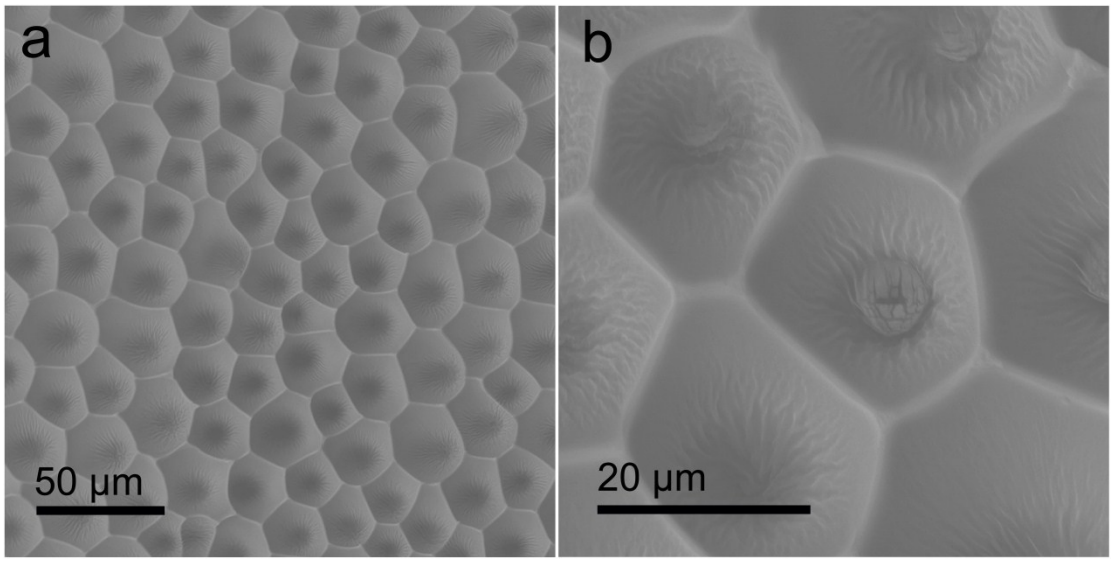

Fig.S2 FESEM images of m-PVA film with different magnifications to show the honeycomb-like structure of surface of m-PVA film.

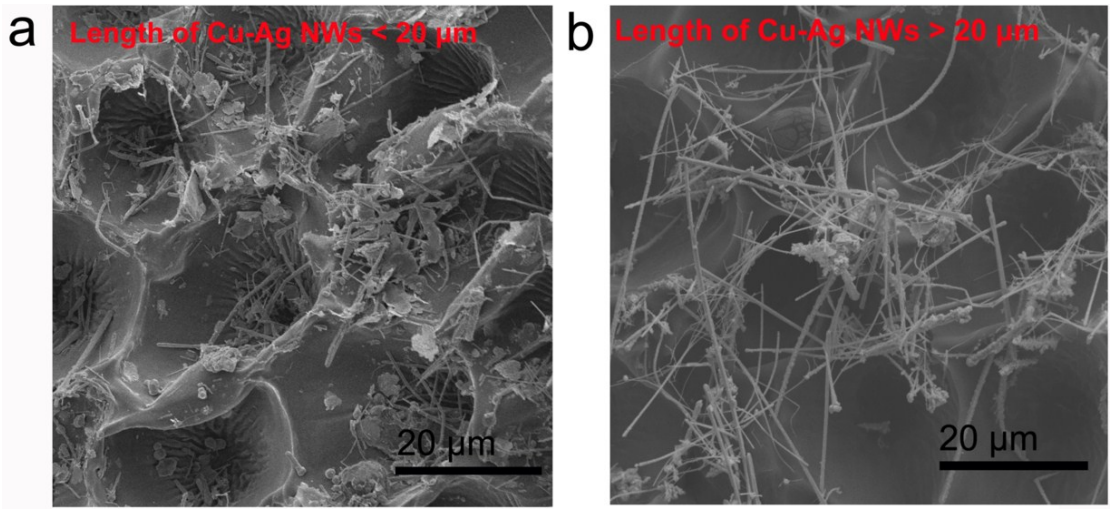

Fig.S3 FESEM images of Cu-Ag NWs with different length dropp-coated on m-PVA film showing that only the Cu-Ag NWs with suitable length (< 20 μm) can penetrate into the honeycomb-like holes on the surface of m-PVA film. To synthesis longer CuNWs (> 20μm), a higher EDA concentration (120 mM) and longer reaction time (2.0 h) was performed.

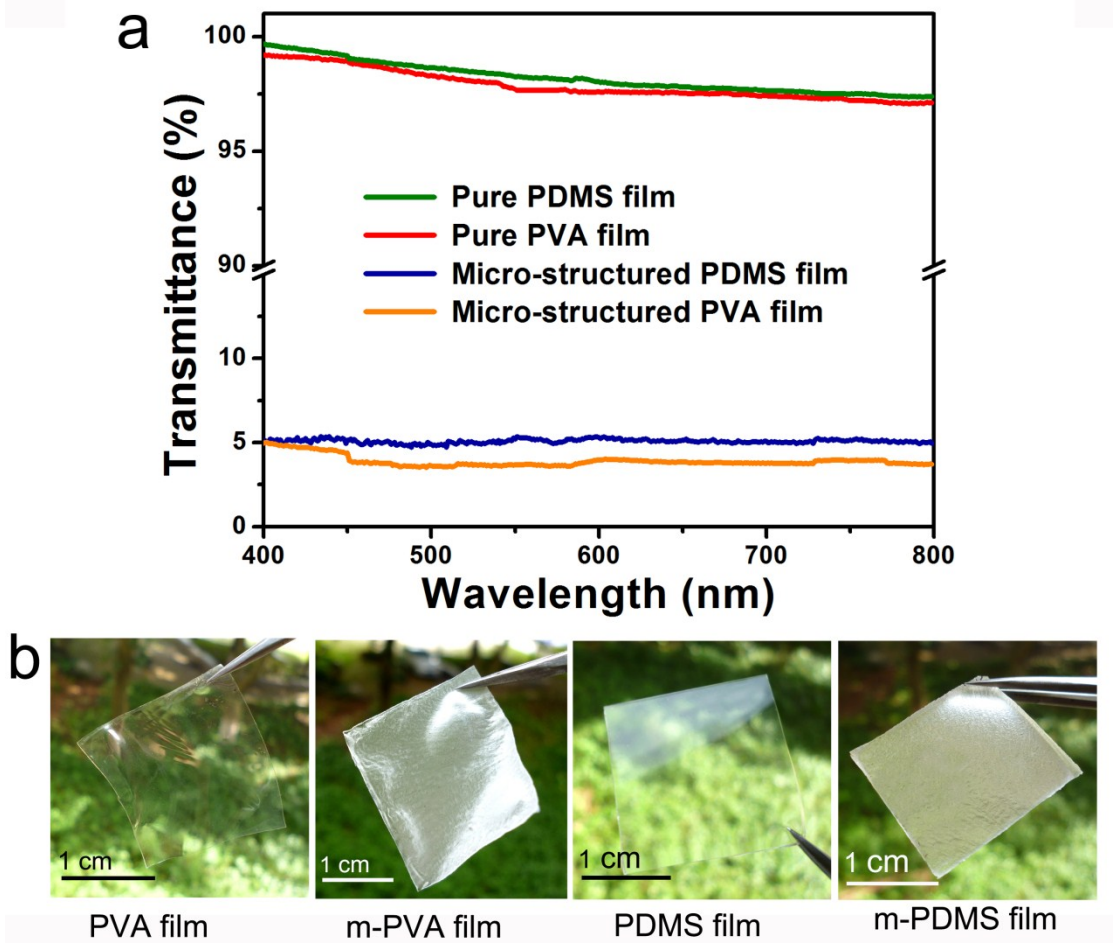

Fig.S4 Optical transmittance (a) and digital photographs (b) of the pure PDMS and PVA film, micro-structured PDMS and PVA film (m-PDMS and m-PVA film).

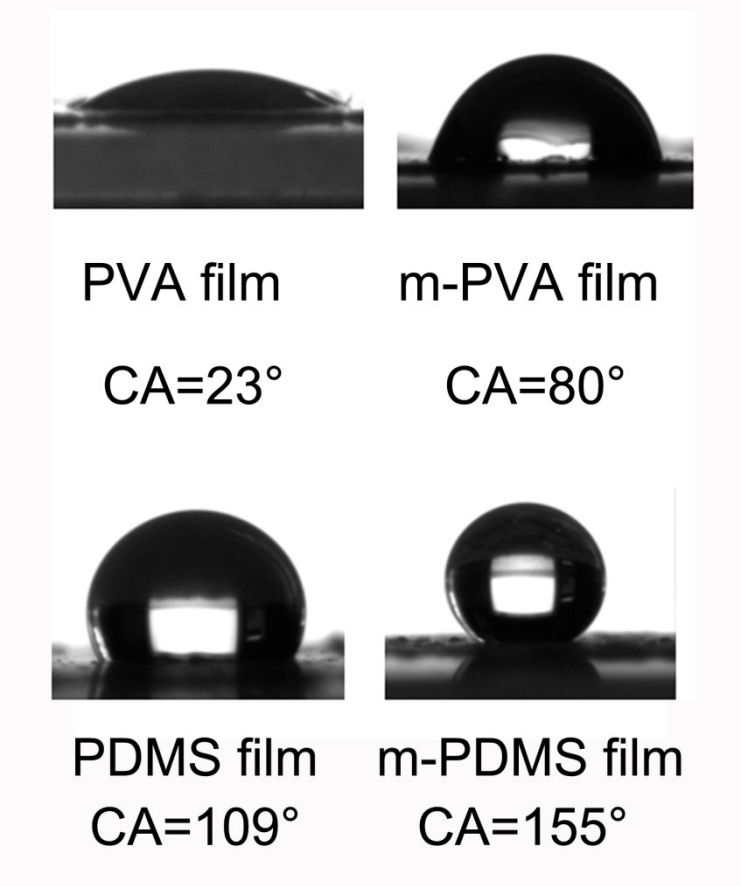

Fig.S5 Contact angle of pure PDMS film, PVA film, m-PDMS and m-PVA film.

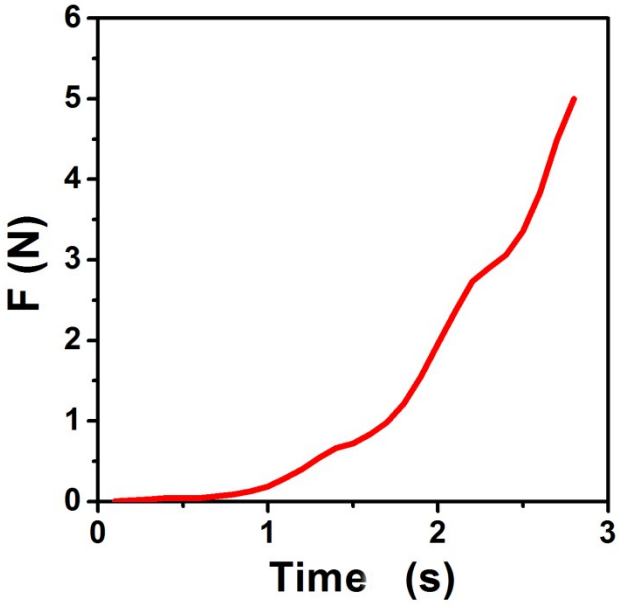

Fig.S6 The force applied to e-skin during the compression test.

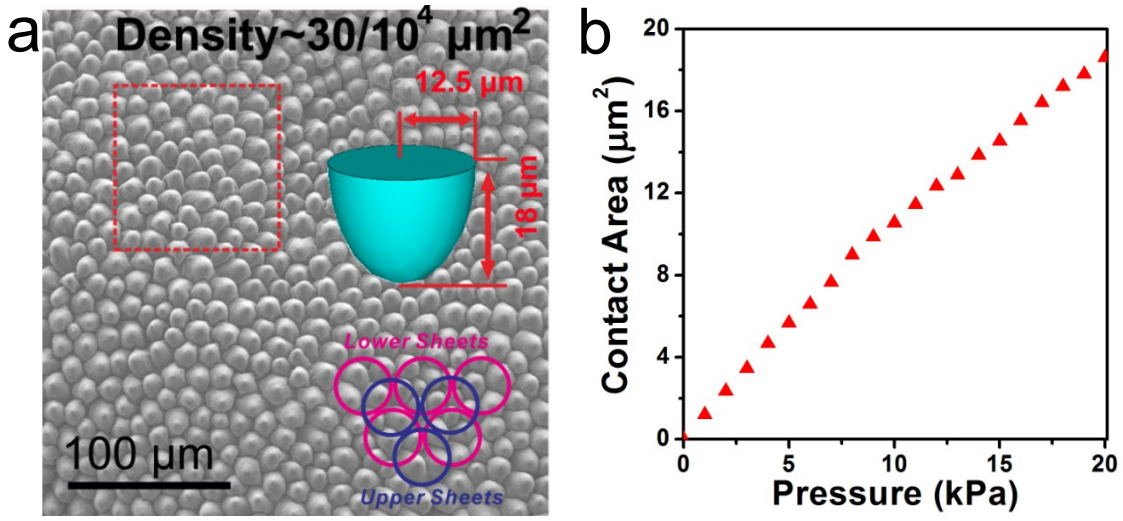

Fig.S7 (a) SEM images of the surface of rose petal to show the information about the micropapillae arrays, which can be approximated as ellipsoids (semiminor and semimajor axis are given as 12.5 μm and 18μm). (b) Change in contact area for the micropapillae arrays as a function of pressure from 0-20 kPa.

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