Supporting Information

Butterfly-scale architecture directed electrodeposition of Ag microband arrays for electrochemical detection

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S1. Electrode fabrication

The *Troides aeacus* butterfly specimens were provided by Shanghai Entomological Museum, China. The yellow hind-wings were selected, clipped by two alumina slides and put into a vacuum furnace for carbonization. Temperature was set to rise gradually from room temperature to 800℃ with a heating rate of 1.5℃/min and held for 3 h to ensure complete carbonization.

Then 3mm x 3mm squares were cut from the carbonized wing samples and carefully pasted on ITO slides with the dimension of 24mm long and 3mm wide using Ag conducting resin. Other conductive areas of ITO slides were wrapped by elastic insulating film leaving only carbonized butterfly-wing scales contacting the electrolyte. A clean atmosphere was required for all procedures to ensure uncontaminated samples.

S2. Electrodeposition

Electrodeposition experiments were performed on a Parstat2273 Potentiostats-Electrochemistry Workstation at room temperature (25℃). A three electrode cell was used with butterfly-wing scale architectured electrodes as electrodepositon substrates (working electrodes), large platinum plate (20x20mm) as auxiliary electrode, and saturated calomel electrode (SCE) as reference electrode.

Electrodeposition solution was prepared by dissolving $AgNO_3$ (0.425 g) and KNO_3 (0.2525 g) in 100 ml deionized water, and then adding $NH_3 \cdot H_2O$ until sediment was formed and disappeared subsequently. The final electrolyte was achieved by further adding deionized water to the solution

in a volumetric flask to 250 ml.

Chronoamperometry method was used by exerting a negative potential on ridge array architectured electrodes under a certain period for electrodeposition.

S3. Finite element simulation

To demonstrate the tip effect for *E* and verify the electrodeposition behavior along ridge arrays, we conducted finite element simulations using Comsol Multiphysics 4.2 software from CnTech. A diffusion domain approach with a one-ridge period as a domain unit was used.[1]

The *E* distribution simulation was performed at the *Electrostatics* branch under *AC/DC* Module of Comsol Multiphysics software. A negative potential was exerted on the electrode models, while a zero potential was applied at an assumed semi-diffusion distance (5 mm). The relative dielectric constant of liquid electrolyte was set to 81. The constitutive relation was defined by Gauss' law in the whole domain.

The electrodeposition simulation was performed at the *Electrodeposition-Deformed Geometry* branch under *Electrochemistry* Module of Comsol Multiphysics software. The ridge arrays were defined as external depositing electrode on which a cathode potential was exerted. The diffusivity of electrolyte and exchange current density for metal deposition were set to 1.7×10^{-9} m^2/s and 100 mA/m^2, respectively.

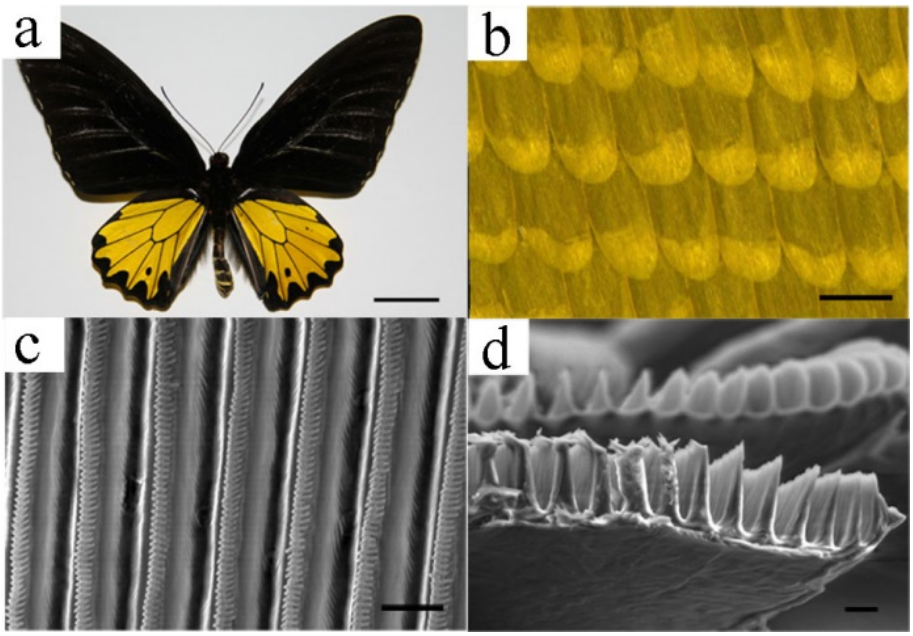

Fig. S1 Overall view and microarchitecture of original *Troides aeacus* butterfly hind-wings. (a) An overall view of the butterfly. Scale bar: 2cm. (b) Optical microscopic image of the scales on yellow hind-wing. Scale bar: 50μm. (c,d) FESEM images showing the front and cross-sectional views of the inverse-V type ridge array architecture of scales, respectively. Scale bar: 2μm.

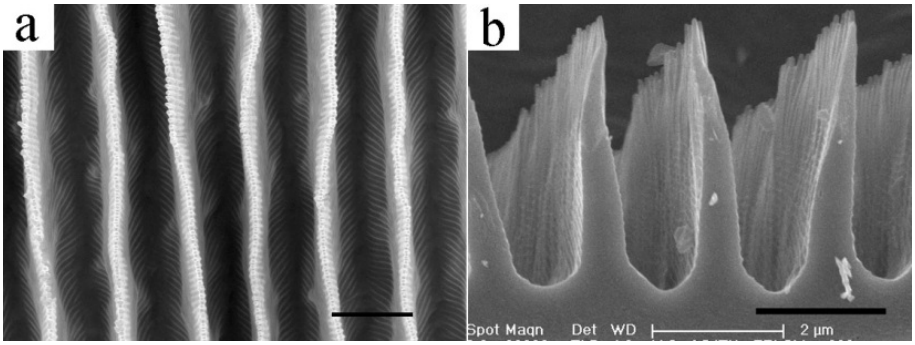

Fig. S2 FESEM images of carbonized butterfly-wing scales. (a) Front view of the ridge array architecture after carbonization. (b) Cross-sectional view of the ridge array architecture after carbonization. Scale bar: 2μm for both. Scale bar: 2μm.

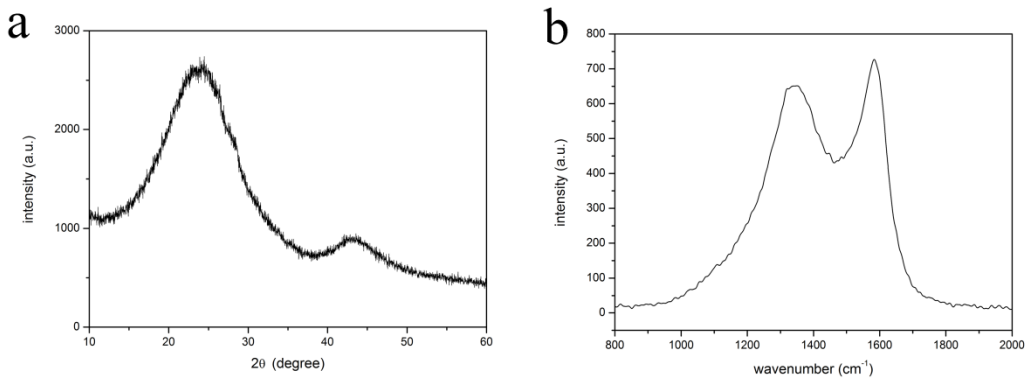

Fig. S3 XRD (a) and Raman (b) Spectra of carbonized butterfly-wing scales.

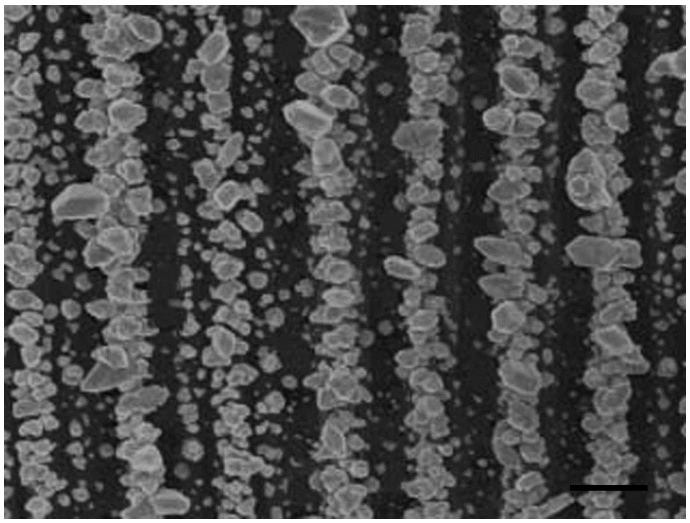

Fig. S4 FESEM image of the Ag deposition morphology achieved under the potential of -0.9 V for 120 s. Scale bar: 2μm.

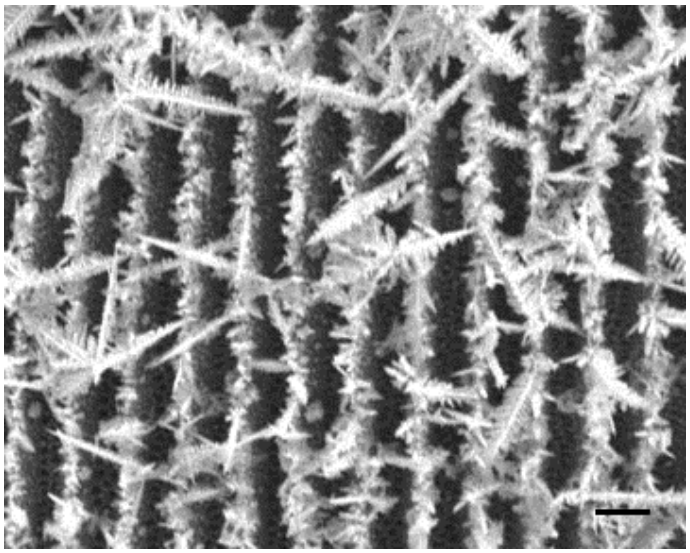

Fig. S5 FESEM image of the Ag deposition morphology achieved under the potential of -1.0 V for 120 s. Scale bar: 2μm.

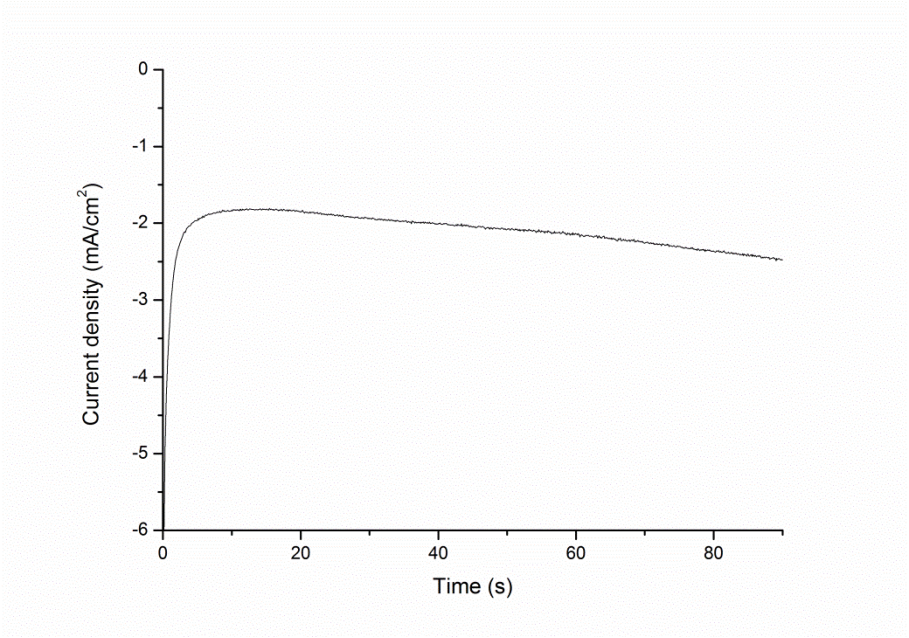

Fig. S6 The chronoamperometric curve for Ag electrodeposition under -0.9 V for 90 s.

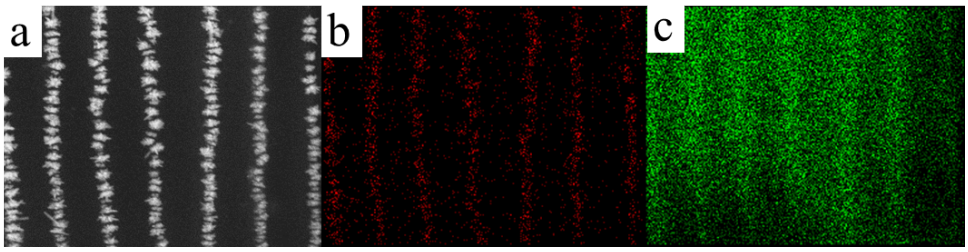

Fig. S7 FESEM image and corresponding EDS elemental mapping of the electrodeposited Ag microband array. (a) FESEM image. (b) Ag mapping. (c) C mapping.

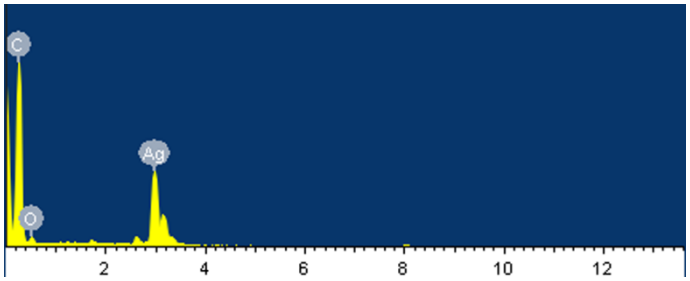

Fig. S8 EDS spectrum of the electrodeposited Ag microband array

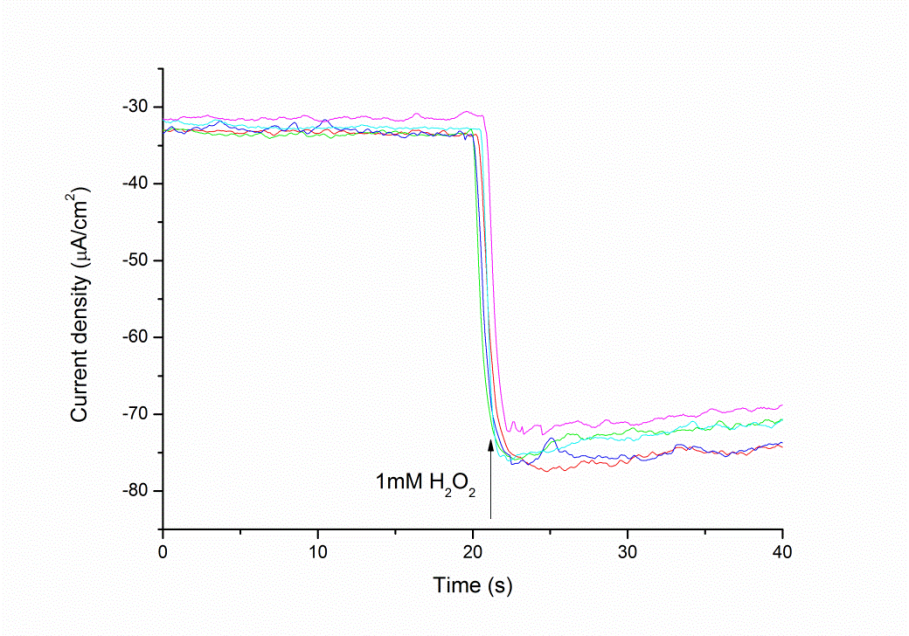

Fig. S9 Amperometric response of five Ag microband array electrodes for the addition of 1mM H_2O_2 at -0.4 V.

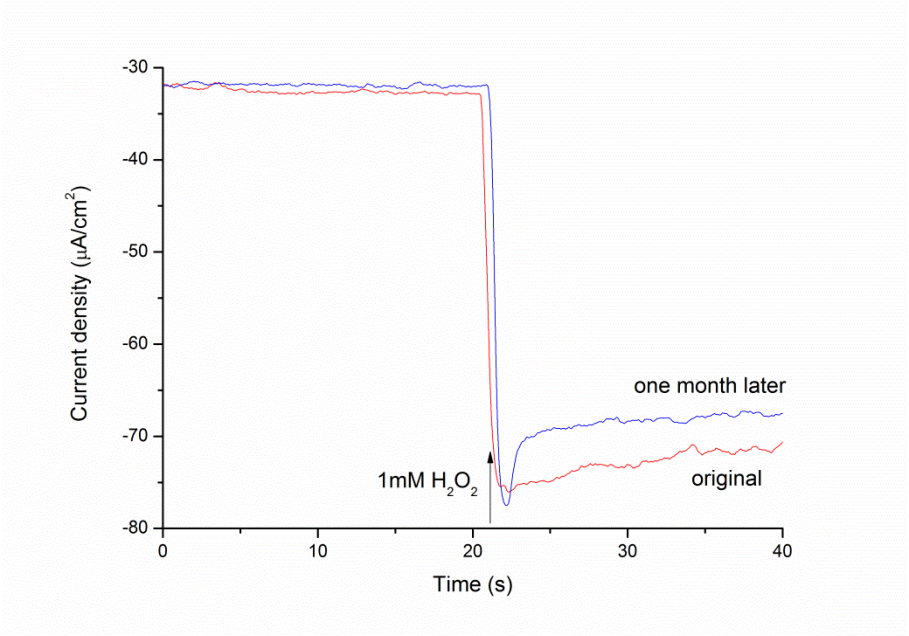

Fig. S10 Amperometric response of the Ag microband electrode over one month storage period for the addition of 1mM H_2O_2 at -0.4 V.

Table S1 Comparation of hydrogen peroxide detection performance based on this work and other Ag based sensors.

H2O2 sensor	Linear range (mM)	Detection limit (μM)	Sensitivity (μA/(mM cm^2))	References
Ag microband array	0.02~24	14	27.1	This work
PVP-AgNWs/GCE	0.02~3.62	2.3	15.9	1
AgNW array	0.1~3.1	29.2	26.6	2
Ag/DNA NPs	0.05~1.2	9	38.3	3
Ag nanoparticle/SiNWs	0.2~70	0.2	8.96	4
AgNPs/CNT/GCE	0.1~10	2	979	5
Nanorough Ag	0.01~22.5	6	1.76 μA/mM	6
Ag/L-Cys/GCE	0.0025~1.5	0.7	3.66 μA/mM	7
Ag/C/Ag/GCE	0.07~10	23	-	8
AgNPs-GN-R/GCE	0.1~40	28	-	9
AgNPs-NFs/GCE	0.1~80	62	-	10
PQ11-AgNPs/GCE	0.1~180	33.9	--	11

References

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