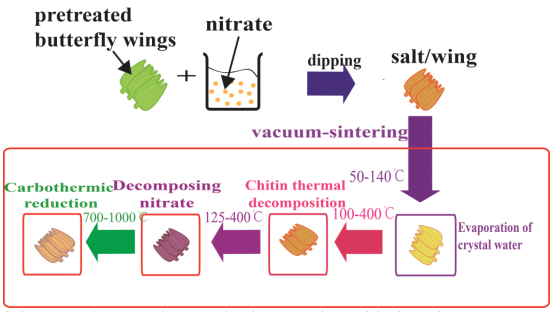
Communication

ESI



Scheme S1: Scheme of the procedure used to synthesize Fe-wing with the microstructure of butterfly wing scales.

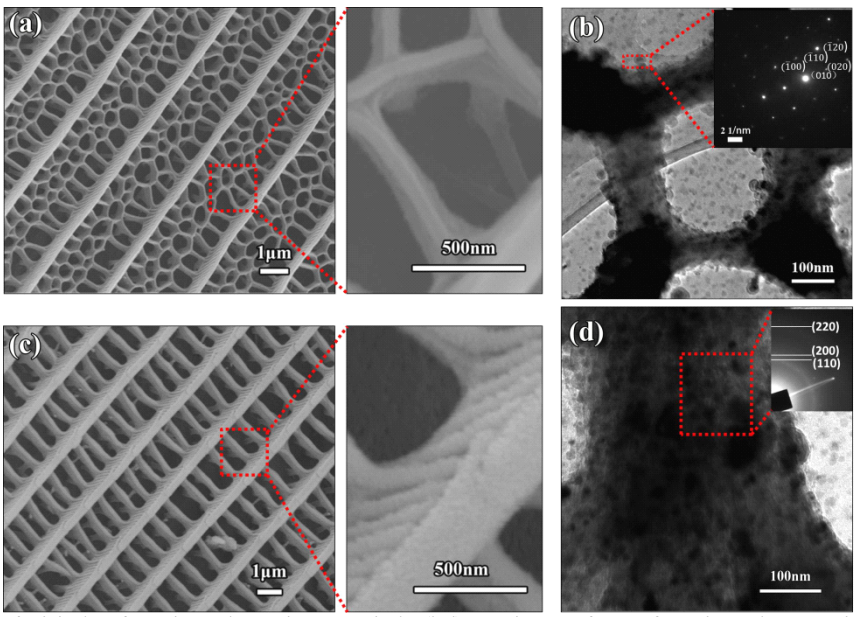


Figure S1: (a,b)SEM images of original PP fore-wing and HG wing respectively; (b,d) TEM images of Fe-PP fore-wing and Fe-HG wing respectively, the inset in (b,d) are the selected-area electron diffraction (SAED) patterns.

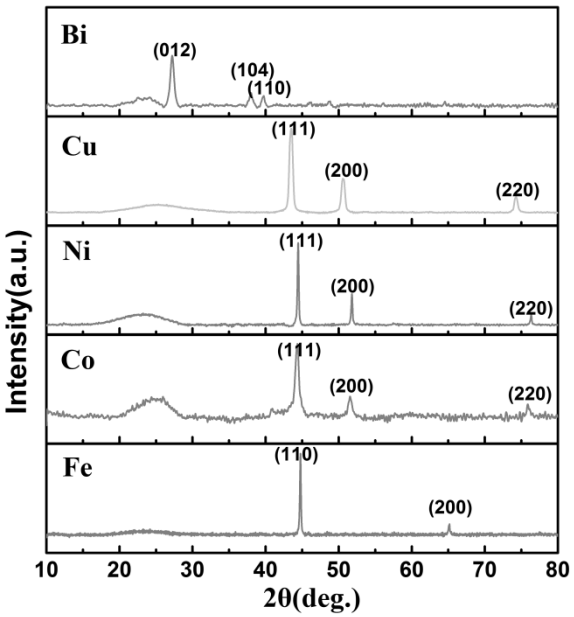


Figure S2: XRD pattern of the Fe-wing in air at room temperature for one month; and XRD patterns of Co, Ni, Cu and Bi-wings calcined in vacuum at 800°C.

The concentration of $Co(NO_3)_2$, $Ni(NO_3)_2$, $Cu(NO_3)_2$ and $Bi(NO_3)_3$ is 0.5g ml^{-1}, 0.4g ml^{-1}, 0.5g ml^{-1} and 0.3g ml^{-1} respectively. And we added 5% HNO_3 into the solution of $Bi(NO_3)_3$ in order to prevent precipitating.

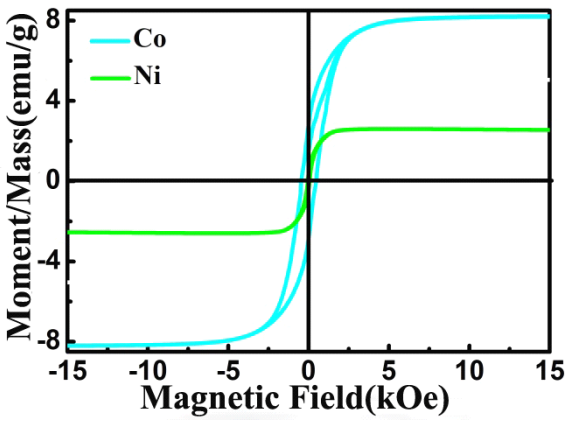


Figure S3: Magnetization loops of Co and Ni-wings.

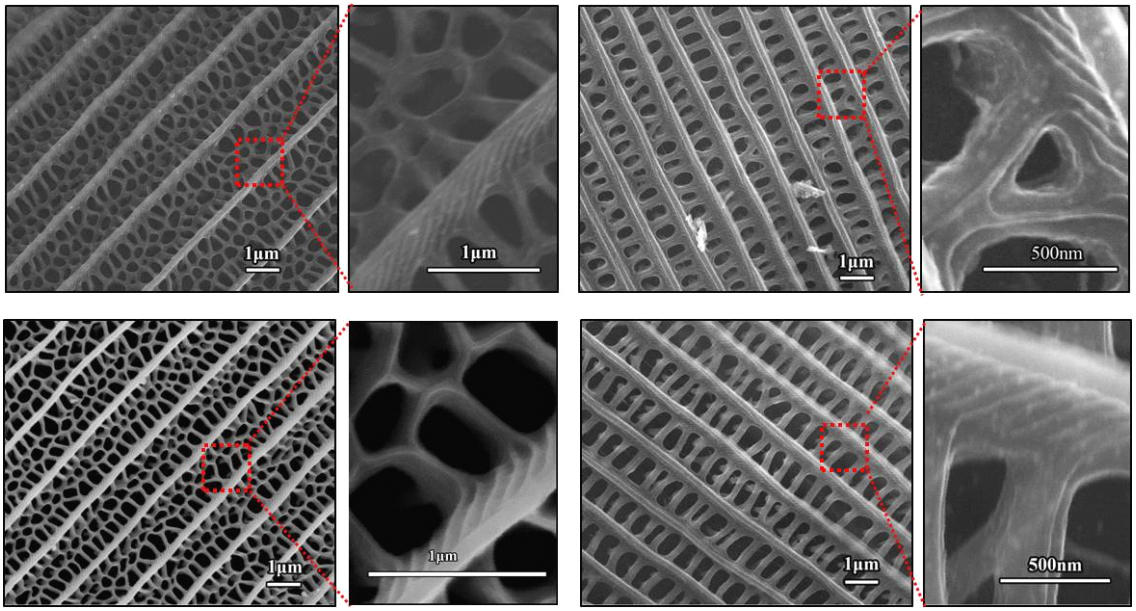


Figure S4: (a1,a2) Surface morphology of as-synthesized Co-wings, (b1,b2) Surface morphology of as-synthesized Ni-wings.

The center image of Scheme.1 shows a machine designed by ourselves to transcribe the microstructures of the metal butterfly wings scales to the surface of the PDMS. It contains a box that has three fitted places to receive three kinds of metal butterfly wings, three buttons that control which metal butterfly wing will be chosen, and a scaffold which has an electromagnet at its tip. For example, if we press the first button, the electromagnet will come near to the corresponding place which contains fitted metal butterfly wing, and suck the metal butterfly wing up, then the metal butterfly wing will be pressed onto the surface of PDMS. After printing, the electromagnet will come near to the corresponding place again, and metal butterfly wing will be put back.

The metal nitrides decomposition happened when the temperature raised to 150-300°C,and the reaction equations show below[1, 2].

$$4Fe(NO_3)_3 \xrightarrow{125℃} 2Fe_2O_3+12NO_2\uparrow+3O_2\uparrow,$$

$$2Co(NO_3)_2 \xrightarrow{242℃} 2CoO+4NO_2\uparrow+O_2\uparrow,$$

$$2Ni(NO_3)_2 \xrightarrow{110℃} 2NiO+4NO_2\uparrow+O_2\uparrow.$$

Then, the oxides obtained from the above reaction with C came from the thermal decomposition of butterfly wing. The temperatures were calculated from their thermodynamic parameters.

$$Fe_2O_3+3C \xrightarrow{702℃} 2Fe+3CO\uparrow,$$

$$CoO+C \xrightarrow{608℃} Co+CO\uparrow,$$

$$NiO+C \xrightarrow{536℃} Ni+CO\uparrow.$$

Their thermodynamic parameters3 are shown blow Table S1。

As $\Delta G^{\theta} = \Delta f\, H_m^{\theta} - TS_m^{\theta}$, when $\Delta G^{\theta} = 0$, this reaction cantake place, so we get the $T = \frac{\Delta f H_m^{\theta}}{S_m^{\theta}}$, the temperature of the initial reaction can be calculated.

Table S1: Thermodynamic parameters of samples.

Materials	$\Delta f\ H_m^{\theta}$ (kJ mol^{-1})	S_m^{θ} (J mol^{-1} K^{-1})
Fe_2O_3	-824.2	87.4
NiO	-239.7	37.99
CoO	-237.94	52.97
CO	-110.525	197.674

Reference

1 H. J. Emeléus and A. G. Sharpe, Advances in inorganic chemistry and radiochemistry, Academic Press,1968,**10**.
2 S. Yuvaraj, L. Fan-Yuan, C. Tsong-Huei and Y. Chuin-Tih, Thermal decomposition of metal nitrates in air and hydrogen environments. The Journal of Physical Chemistry B, 2003, **107(4)**,1044-1047.
3 H. W. Wan, Z. K. Zhan, Physical Chemistry, Higher Education Press, 2002, 521-528.