*Supporting Information*

# Design of Cobalt Phosphate/Nickel hosphate Film with Improved Electrochromic Performance

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**Supplementary Table**

Table S1. EC properties of the NiO films with porous nanostructures.

| materials | optical modulation | coloration efficiency ($cm^2 C^{-1}$) | switching time tc/tb | cycle stability | reference |
|---|---|---|---|---|---|
| NiO | 78.5% at 550nm | 51.8 | 3.92s / 3.43s | 1000 | [1] |
| NiO | 51% at 550nm | 40 | 7s /5s | 3000 | [2] |
| $NiCoO_2$ | 64.2% at 550nm | 33.6 | 6.8 / 6.7s | 200 | [3] |
| NiHCF | 17.5% at 400nm | / | 21.5min / 8.5s | 55 | [4] |
| Li-Ti-NiO | 56% at 580nm | 21.8 | 0.9s / 1.0s | 300 | [5] |
| Sn-NiO | 65.1% at 550nm | 39.3 | 1.3s / 1.4s | 500 | [6] |
| rGO-NiO | 53% at 630nm | 30.5 | 3.4s / 5.3s | 1000 | [7] |
| OL-NiO | 54.27% at 450nm | 48.5 | 3.2s / 2.7s | / | [8] |
| $NiHPO_4$ | 90.8% at 500nm | 75.4 | 7.1/9.6 | 300 | [9] |
| $CoHPO_4/NiHPO_4$ | 65.55% at 500nm | 140.37 | 2.0/8.5 | 1400 | This work |

Table S2. Anode and cathode peak current density *vs* (scan rate)$^{1/2}$ plot obtained from CV curves, corresponding linear fits of the CoHP/NiHP-1 film, CoHP/NiHP-2 film, CoHP/NiHP-3 film, CoHP/NiHP-4 film, CoHP/NiHP-5 film CoHP/NiHP-6 film.

| | CoHP/NiHP-1 film | CoHP/NiHP-2 film | CoHP/NiHP-3 film | CoHP/NiHP-4 film | CoHP/NiHP-5 film | CoHP/NiHP-6 film |
|---|---|---|---|---|---|---|
| **Oxidative linear fits** | $I=-0.456+0.77 \times v^{1/2}$ $R^2=0.99952$ | $I=-1.1818+1.28 \times v^{1/2}$ $R^2=0.99985$ | $I=-1.15+1.49 \times v^{1/2}$ $R^2=0.99913$ | $I=-0.48+1.64 \times v^{1/2}$ $R^2=0.99981$ | $I=0.252+1.59 \times v^{1/2}$ $R^2=0.99942$ | $I=0.756+1.52 \times v^{1/2}$ $R^2=0.99945$ |
| **Reductive linear fits** | $I=0.392-0.66 \times v^{1/2}$ $R^2=0.99976$ | $I=-0.925-1.04 \times v^{1/2}$ $R^2=0.99967$ | $I=1.03-1.23 \times v^{1/2}$ $R^2=0.99917$ | $I=0.45-1.28 \times v^{1/2}$ $R^2=0.99972$ | $I=-0.018-1.23 \times v^{1/2}$ $R^2=0.99911$ | $I=-0.796-1.19 \times v^{1/2}$ $R^2=0.99942$ |

**Table S3.** Anode and cathode peak current density *vs* (scan rate)$^{1/2}$ plot obtained from CV curves, corresponding linear fits and diffusion coefficient of the CoHP film, NiHP film and $CoHPO_4$/$NiHPO_4$ film (CoHP/NiHP-4 film).

| | CoHP film | NiHP film | CoHP/NiHP-4 film |
|---|---|---|---|
| **Oxidative linear fits** | $I=-2.31+1.37 \times v^{1/2}$ $R^2=0.99904$ | $I=-1.05+1.49 \times v^{1/2}$ $R^2=0.99979$ | $I=-0.48+1.64 \times v^{1/2}$ $R^2=0.99981$ |
| **Reductive linear fits** | $I=1.85-1.25 \times v^{1/2}$ $R^2=0.99937$ | $I=-0.51-1.08 \times v^{1/2}$ $R^2=0.99935$ | $I=0.45-1.28 \times v^{1/2}$ $R^2=0.99972$ |

**Table S4.** The transmittance of initial state, bleached state and color state of the CoHP/NiHP-1 film, CoHP/NiHP-2 film, CoHP/NiHP-3 film, CoHP/NiHP-4 film, CoHP/NiHP-5 film CoHP/NiHP-6 film.

| | CoHP/NiHP-1 film | CoHP/NiHP-2 film | CoHP/NiHP-3 film | CoHP/NiHP-4 film | CoHP/NiHP-5 film | CoHP/NiHP-6 film |
|---|---|---|---|---|---|---|
| $T_{initial}$ | 94.86% | 93.90% | 91.45% | 89.53% | 88.72% | 88.13% |
| $T_{bleached}$ | 88.25% | 87.62% | 87.33% | 87.03% | 85.94% | 85.39% |
| $T_{colored}$ | 63.25% | 42.57% | 28.99% | 21.48% | 20.09% | 19.15% |
| **ΔT** | 25.00% | 45.05% | 58.34% | 65.55% | 65.85% | 66.24% |

**Supplementary Figures**

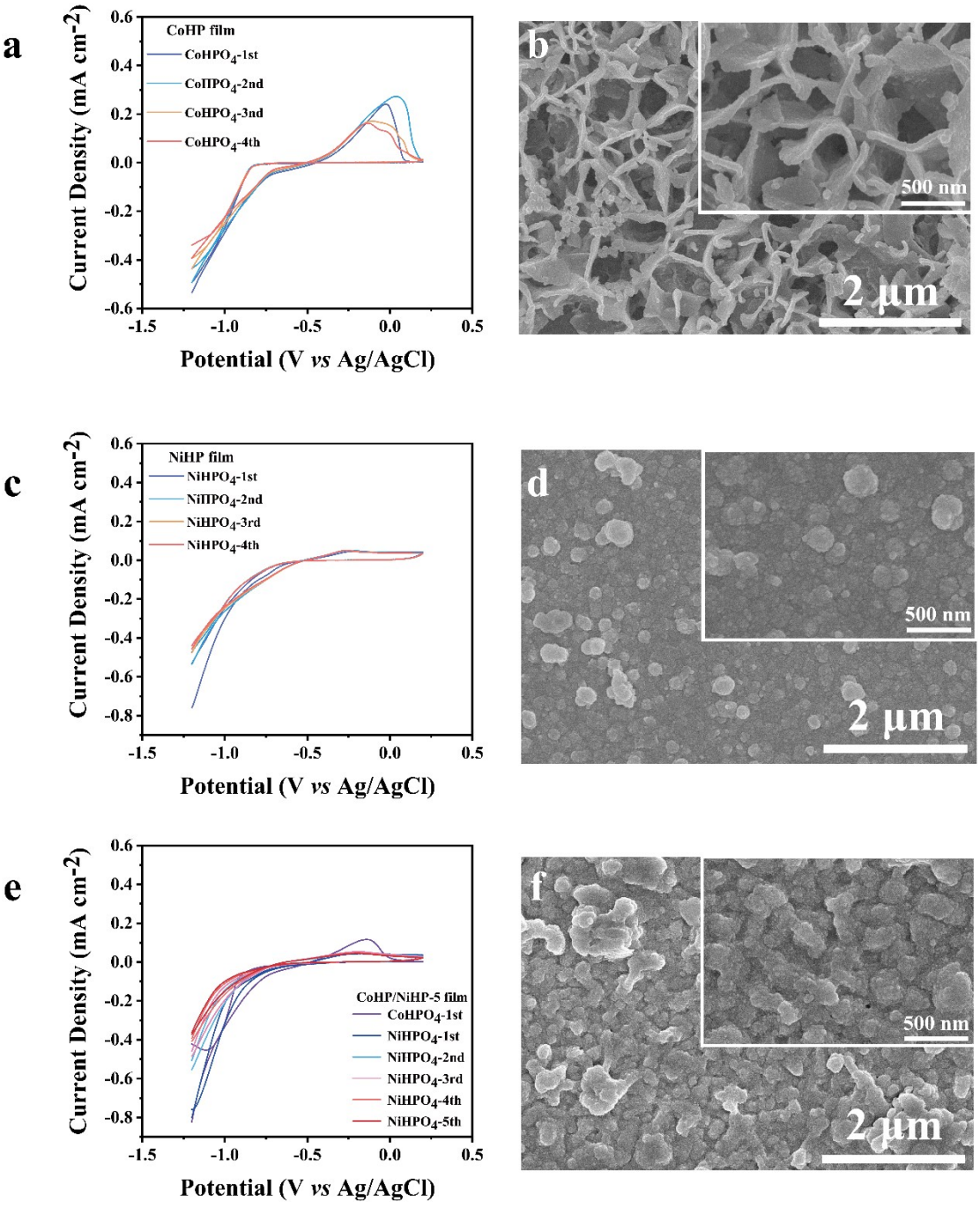


**Fig. S1** The two-step electrochemical deposition CV curves while prepared (between -1.2 and 0.2 V *vs.* Ag/AgCl, 20 mV $s^{-1}$) and corresponding top-view SEM images of (a-b) CoHP film, (c-d) NiHP film and (e-f) CoHP/NiHP-5 film.

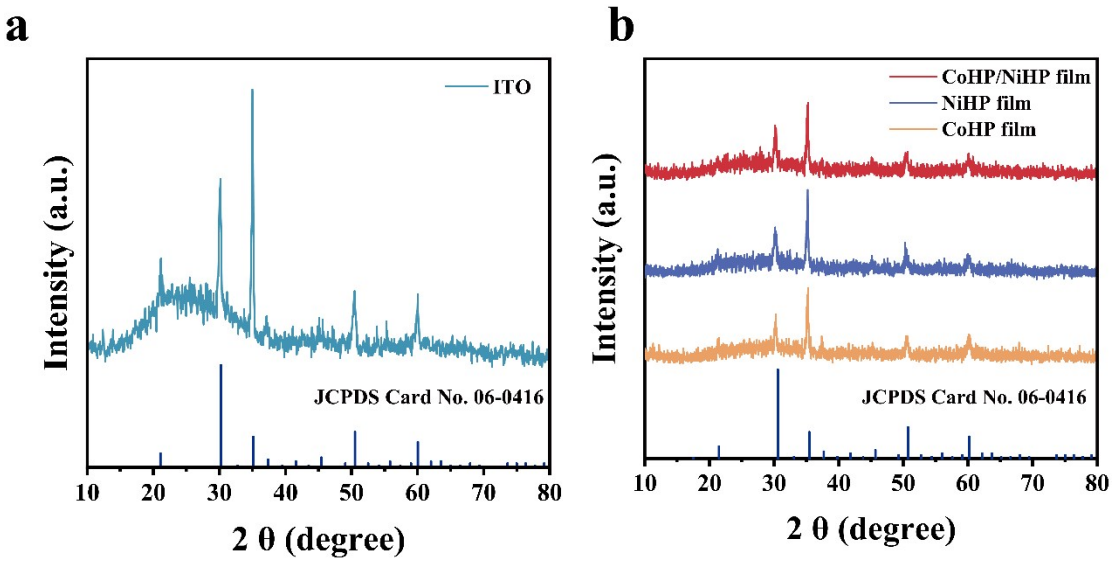


**Fig. S2** XRD patterns of (a) purchased clean ITO glass and (b) CoHP film, NiHP film and CoHP/NiHP film.

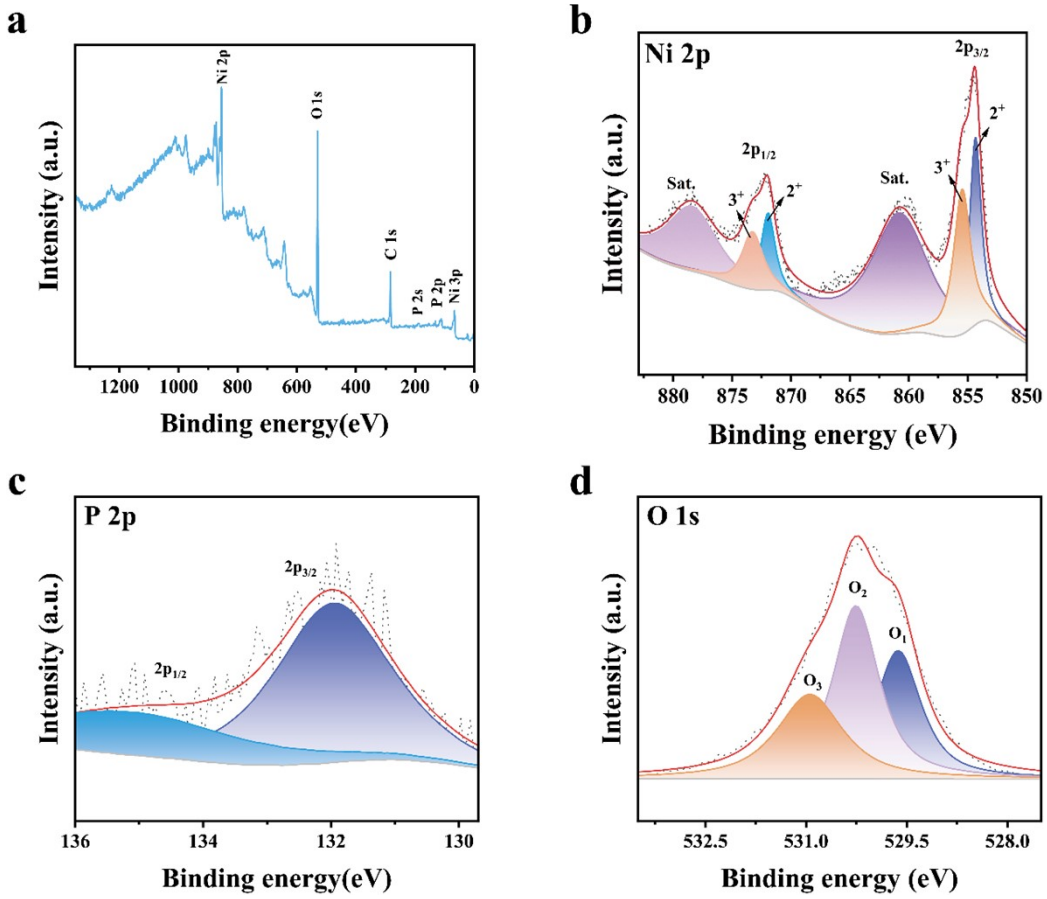


**Fig. S3** (a) XPS spectrum of the NiHP film, (b-d) Ni 2p, O 1s and P 2p spectrum of the NiHP film.

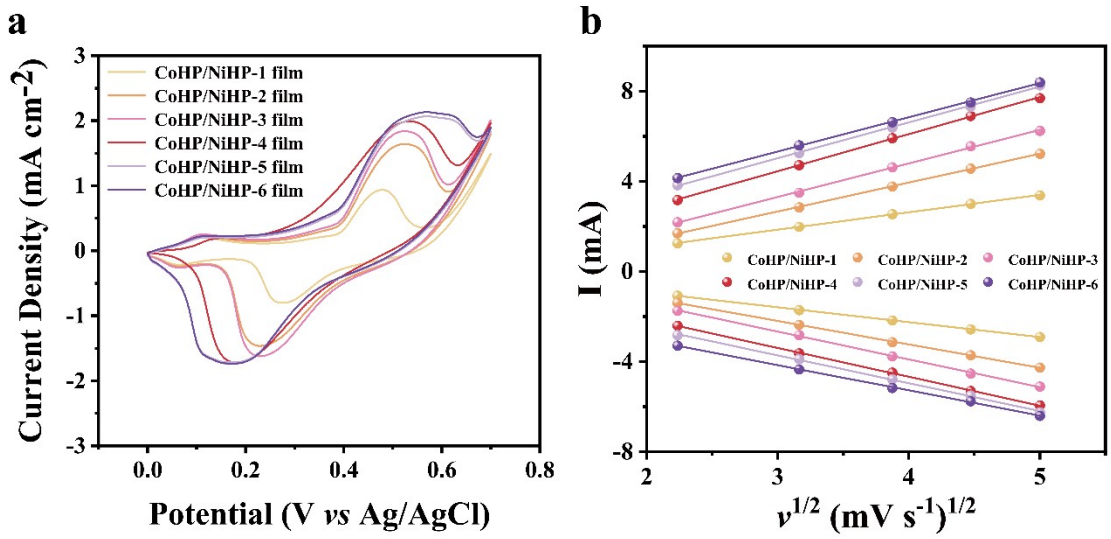


**Fig. S4** (a) CV curve comparison between CoHP/NiHP-1 film, CoHP/NiHP-2 film, CoHP/NiHP-3 film, CoHP/NiHP-4 film, CoHP/NiHP-5 film CoHP/NiHP-6 film at the scan rate of 20 mV s-1, (b) Anode and cathode peak current density vs (scan rate)$^{1/2}$ plot obtained from CV curves and corresponding linear fits of the CoHP/NiHP-1 film, CoHP/NiHP-2 film, CoHP/NiHP-3 film, CoHP/NiHP-4 film, CoHP/NiHP-5 film CoHP/NiHP-6 film.

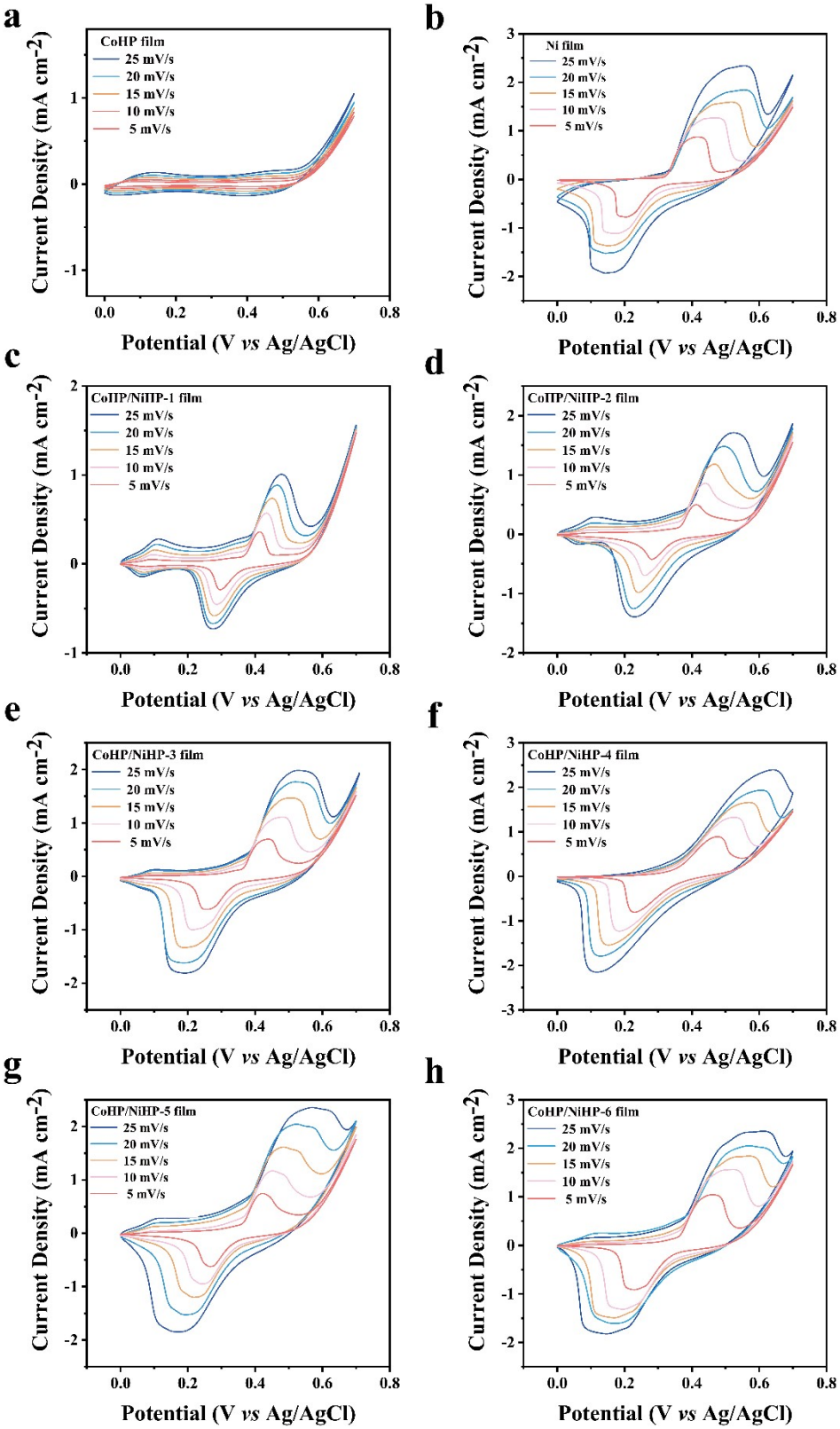


**Fig. S5** CV curves of (a) CoHP film, (b) NiHP film (c) CoHP/NiHP-1 film,(d) CoHP/NiHP-2 film,(e) CoHP/NiHP-3 film,(f) CoHP/NiHP-4 film, (g)CoHP/NiHP-5 film and (h) CoHP/NiHP-6 film at various scan rates from5 mV $s^{-1}$ to 25 mV $s^{-1}$.

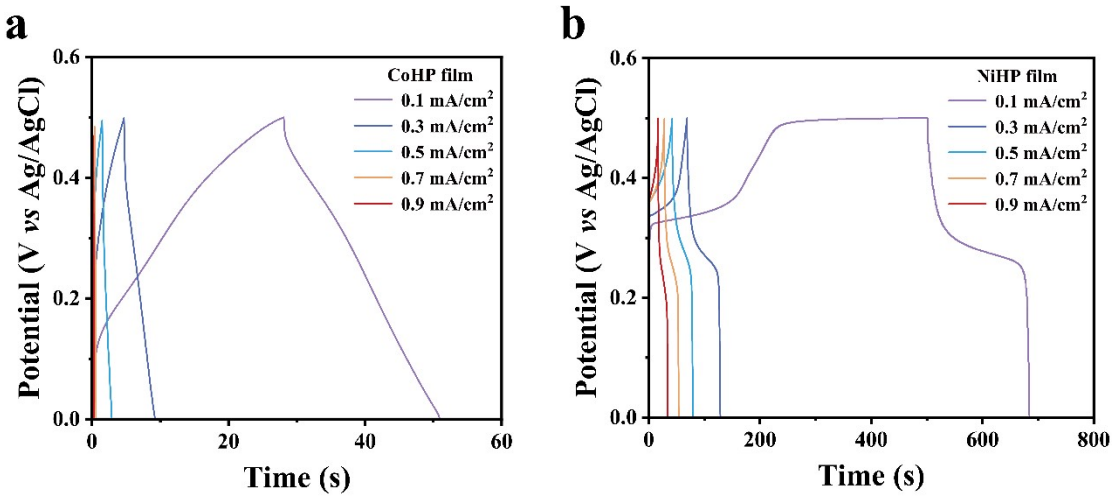


**Fig. S6** GCD curves of (a) CoHP film and (b) NiHP film in 0.1 M KOH under multiple discharging current densities.

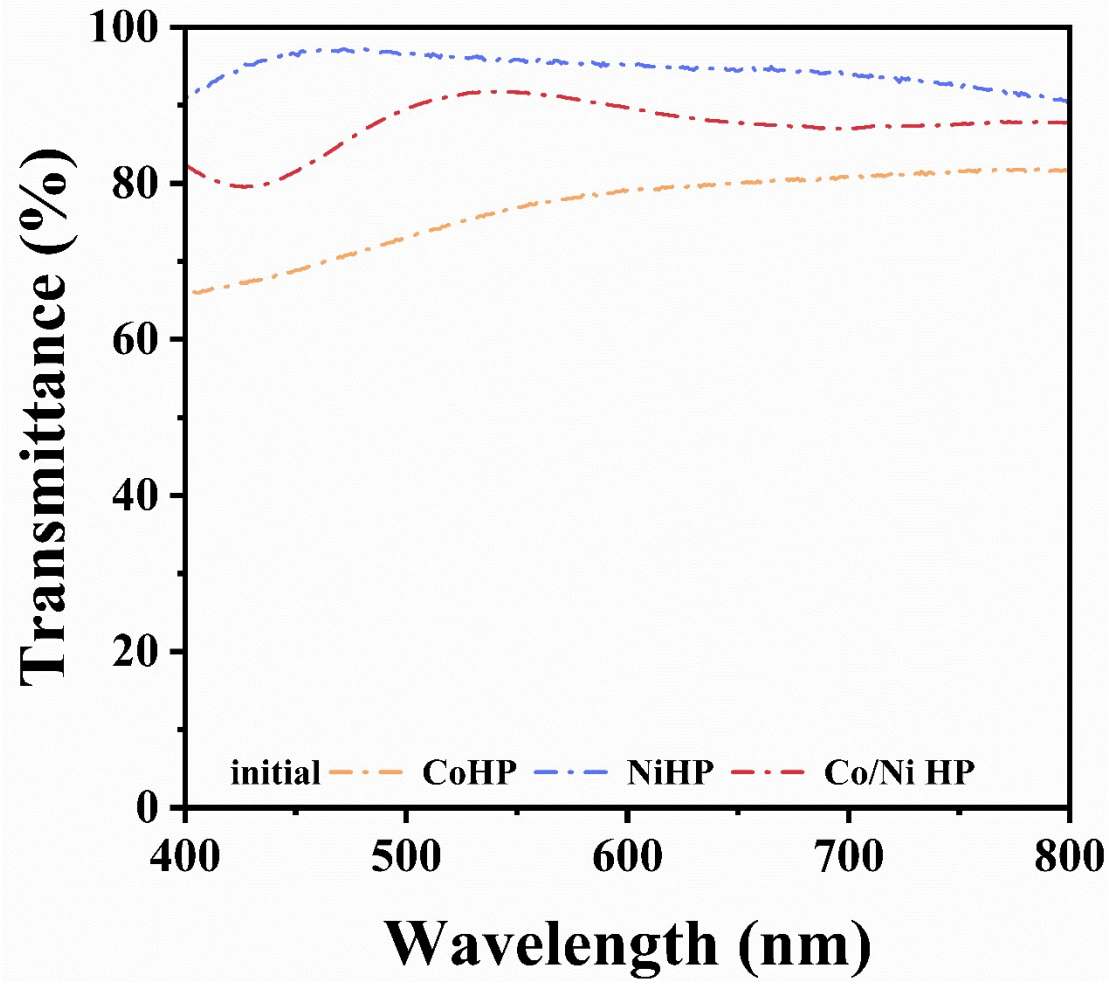


**Fig. S7** Initial state of CoHP film, NiHP film and CoHP/NiHP film.

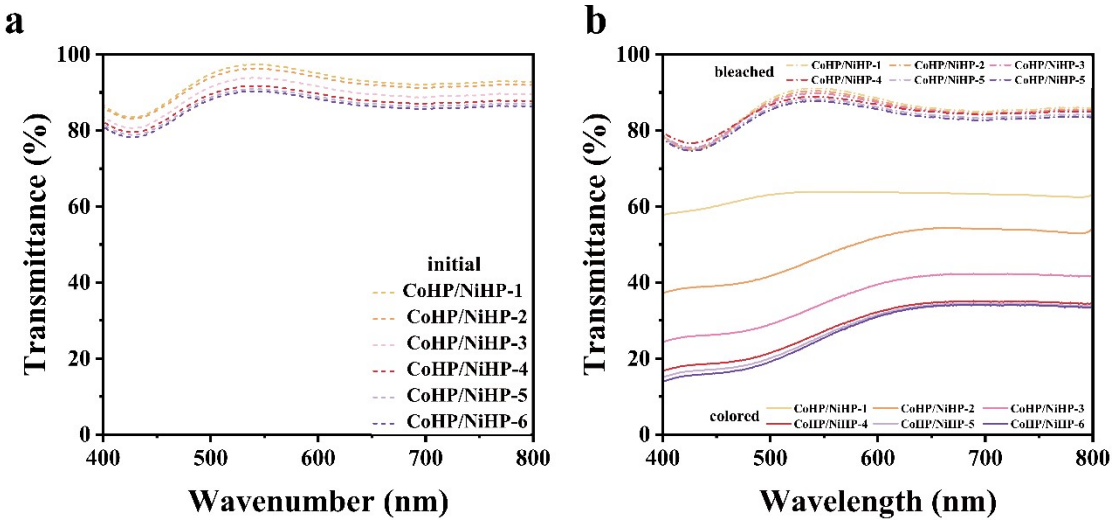


**Fig. S8** (a)The initial state transmittance and (b) the bleached state and the colored state of CoHP/NiHP film with different numbers of electrodeposited CV cycles.

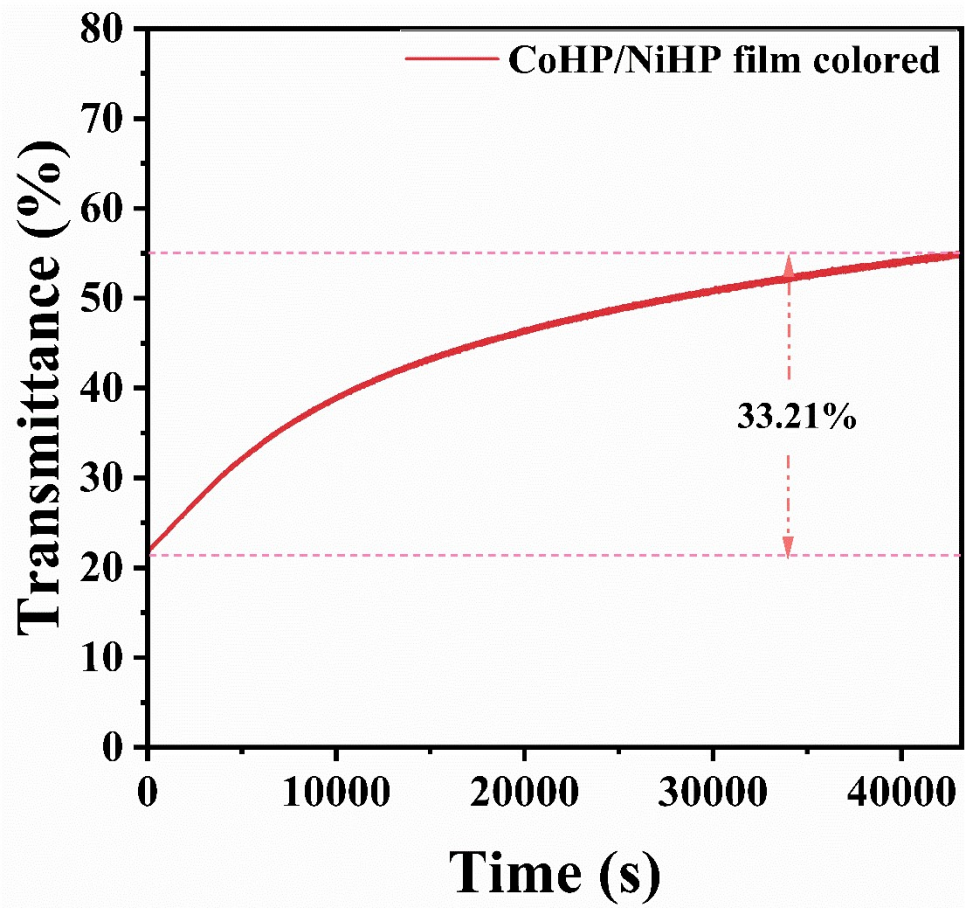


**Fig. S9** Optical memory at 500 nm of the CoHP/NiHP film at stimulation voltages of 0.7 V (*vs.* Ag/AgCl) for 60 s, power off for 43200 s.

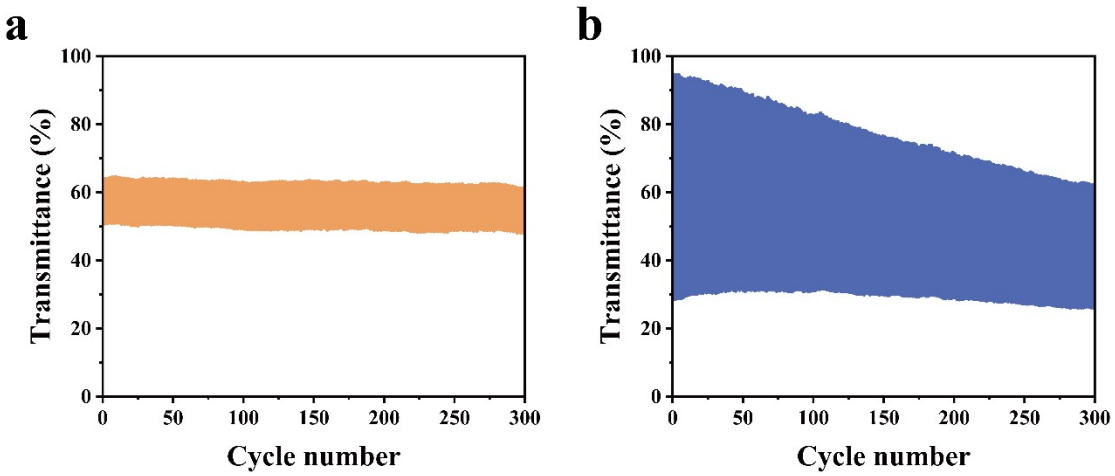


**Fig. S10** 300 cycles cyclic stability measurement of (a) CoHP film and (b) NiHP film at 500 nm by chronoamperometry and in-situ spectroscopic response.

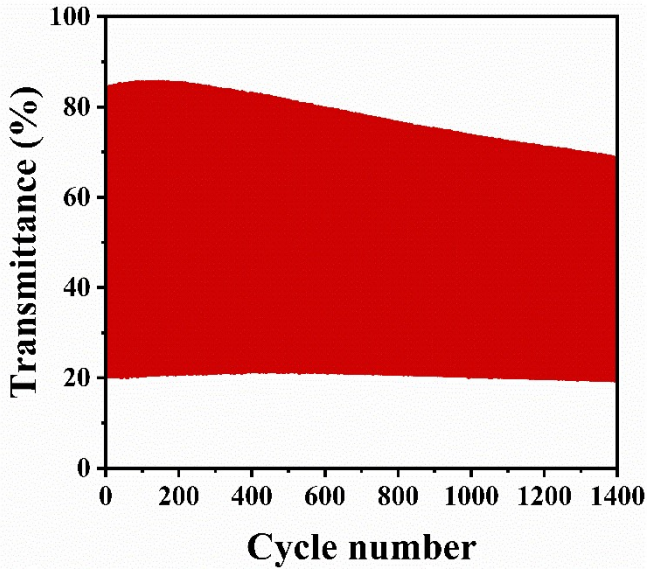


**Fig. S11** 1400 cycles cyclic stability measurement of CoHP/NiHP film at 500 nm by chronoamperometry and in-situ spectroscopic response.

**Reference:**


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