Electronic Supplementary Information

Large-area Co(OH)$_2$ Nanoflower Array Films Decorated with Ag Nanoparticles as Sensitive SERS Substrates

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Part I: Figure S1 to S8

Fig. S1 SEM images of PAN nanopillar
Fig. S2 Co(OH)$_2$ nanosheets synthesized with deposition current of 0.75 mA/cm$^2$ for 6 min.

Fig. S3 (a-b) TEM image of Ag@Co(OH)$_2$ nanoflowers broken off from the Ag@Co(OH)$_2$ nanoflower arrays shown in Fig. 3e.

Fig. S4 EDS spectrum of Ag@Co(OH)$_2$ nanoflower arrays shown in Fig. 3e.
**Fig. S5** XRD of Ag@Co(OH)$_2$ nanoflower arrays shown in Fig. 3e.

**Fig. S6** UV-vis spectra of Ag@Co(OH)$_2$ nanoflower arrays prepared with different Ag-sputtering durations.

**Fig. S7** (a-c) SEM images of Co(OH)$_2$ nanoflower arrays prepared under different deposition currents for 9 min: (a-b) 0.5 mA/cm$^2$, (c-d) 0.75 mA/cm$^2$, (e-f) 1.0 mA/cm$^2$. 
**Fig. S8** Diameter of Co(OH)$_2$ nanoflowers obtained at different deposition durations (3-12 min). The error bars were obtained based on 40 independent measurements.

**Fig. S9** SEM images of Ag NPs sputtered on corresponding Co(OH)$_2$ nanoflower arrays shown in Fig. S7. The Ag-sputtering duration was set as 12 min.

**Fig. S10** SERS spectra of 10$^{-7}$ M R6G collected on Ag NPs sputtered on Co(OH)$_2$ nanoflower
arrays shown in Fig. S9.

**Fig. S11** The linear relationship between the concentration of the thiram molecules and the SERS intensity at 1382 cm\(^{-1}\). The error bars were obtained based on five independent measurements.

**Part S2: Estimation of enhancement factor**

The enhancement factor is calculated to verify the sensitivity of the substrate. The peak at 1078 cm\(^{-1}\) (for 4-ATP molecules) was used to estimate the enhancement factor (EF). The EF can be calculated by the following equation:

\[
EF = \left( \frac{I_{SERS}}{I_{Ref}} \right) \cdot \left( \frac{N_{Ref}}{N_{SERS}} \right)
\]

Where \(I_{SERS}\) and \(I_{Ref}\) represent the SERS intensity of 1 μL 10\(^{-9}\) M 4-ATP alcoholic solution dispersed on 25 mm\(^2\) substrates and 1 μL 10\(^{-3}\) M 4-ATP ethanol solution on 28 mm\(^2\) Si wafer, respectively; \(N_{SERS}\) and \(N_{Ref}\) represent the number of 4-ATP molecules exposed to the laser on the Ag@Co(OH)\(_2\) substrates and Si wafer during the SERS measurement. Herein, a certain concentration (\(C_{SERS}\)) and volume (\(V_{SERS}\)) 4-ATP ethanol solution was dispersed to an area of \(S_{SERS}\) at the Ag@Co(OH)\(_2\) substrates. For non-SERS Raman spectra, a certain volume (\(V_{Ref}\)) and concentration (\(C_{Ref}\)) 4-ATP ethanol solution was dispersed to an area of \(S_{Ref}\) at Si substrate. Both the substrates were dried in the air. Then the foregoing equation becomes:

\[
EF = \left( \frac{I_{SERS}}{I_{Ref}} \right) \cdot \frac{(C_{Ref}V_{Ref})}{(C_{SERS}V_{SERS})} \cdot \frac{(S_{SERS})}{(S_{Ref})}
\]

According to the calculation, average enhancement factor for the band at 1078 cm\(^{-1}\) is about 1.77 \(
\times 10^7\).

**Figure for estimation of enhancement factor:**
Fig. S10 (a) Raman spectrum of 4-ATP obtained by dispersing 1 μL $10^{-3}$ M 4-ATP alcoholic solution on 28 mm$^2$ Si wafer. (b) SERS spectrum of 1 μL $10^{-9}$ M 4-ATP alcoholic solution dispersed on 25 mm$^2$ substrates. The exposure time was 60 s.