Hydrothermal Synthesis of Nanostructured Flower-like Ni(OH)$_2$
Particles and their Excellent Sensing Performance towards Low
Concentration HCN Gas

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Fig. S1 Typical SEM images of Ni(OH)$_2$ products fabricated at varied hydromal temperatures under otherwise identical conditions (SDBS/Ni molar ratio: 0.1, reaction time: 7 h): (a,c) 80 °C, (b,d) 140 °C.
Fig. S2 Typical SEM and TEM images of Ni(OH)$_2$ products synthesized using varied periods of reaction time under otherwise identical conditions (SDBS/Ni molar ratio: 0.1, hydromal temperature: 100 °C): (a,c): 3 h, (b,d): 12 h.
**Fig. S3** Schematic illustration of the formation of hierarchically structured Ni(OH)$_2$ particles.
Fig. S4 Response profiles of Ni(OH)$_2$ modified QCM resonator towards: (a) acetone, (b) ethyl ether, (c) water, (d) ethanol. The Ni(OH)$_2$ was prepared using a SDBS/Ni molar ratio of 0.1 at 140 °C for 7 h.
**Fig. S5** Mass spectra of HCN effluent before (a) and after (b) contact with Ni(OH)$_2$ modified QCM resonator.
Fig. S6 XPS O 1s spectra of Ni(OH)$_2$ prepared using a SDBS/Ni molar ratio of 0.1. The hydrothermal temperature and reaction time are 100 °C and 7 h, respectively.
Calculation of the active oxygen molecules mole number

1. Estimated by calculating the vacancy sites mole number of coated Ni(OH)$_2$ from XPS measurements

   The surface molar ratio of Ni/vacancy sites is estimated to be 2:1 from XPS measurements (Fig. 7b). Thus, the active oxygen molecules mole number can be obtained by the following equation:

   $$ n_{o_2} = \frac{n_{Ni(OH)_2}}{2} = \frac{m_{Ni(OH)_2}}{2 \times M} $$

   Where $m \ (g)$ is the coating mass of Ni(OH)$_2$, $M$ is the molar mass of Ni(OH)$_2$.

   The coating mass of Ni(OH)$_2$ is 6 $\mu$g and the molar mass of Ni(OH)$_2$ is 92.7 g/mol. Therefore, the mole number of active oxygen molecules is calculated to be $3.24 \times 10^{-8}$ mol.

2. Estimated by calculating the vacancy sites mole number of coated Ni(OH)$_2$ from QCM measurements

   From the Sauerbrey equation, we can obtain the mass decrease of coated Ni(OH)$_2$. If this mass decrease is due to the removal of active oxygen molecules, we can then
obtain the mole number of active oxygen molecules from the following equation:

\[
n_{o_2} = \frac{A \times \Delta F}{-2.26 \times 10^{-6} \times F_0^2 \times M}
\]

Where \( A \) (cm\(^2\)) is the sensing surface area, \( \Delta F \) (Hz) is the frequency shift from initial HCN contact to sensing equilibrium, \( F_0 \) (Hz) is the base frequency of quartz crystal, \( M \) is the molar mass of oxygen molecule.

From the above parameters, where \( A = 0.39 \text{ cm}^2 \), \( \Delta F = 1011 \text{ Hz} \), \( F_0 = 9001274.5 \text{ Hz} \), \( M = 32 \text{ g/mol} \), we can therefore calculate the mole number of active oxygen molecules as \( 6.73 \times 10^{-8} \text{ mol} \).