

## Supporting Information

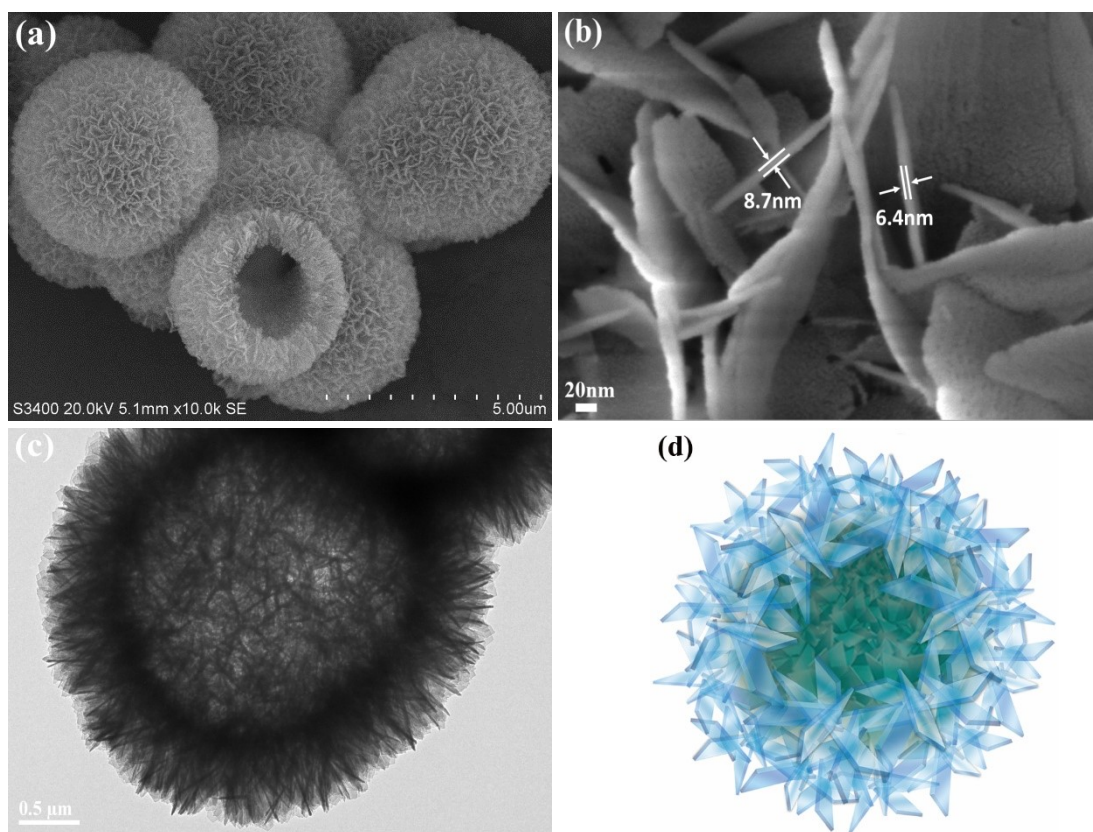
### **Robust nanosheet-assembled Al<sub>2</sub>O<sub>3</sub> supported Ni catalyst for dry reforming of methane: Effect of nickel content on catalytic performance and carbon formation**

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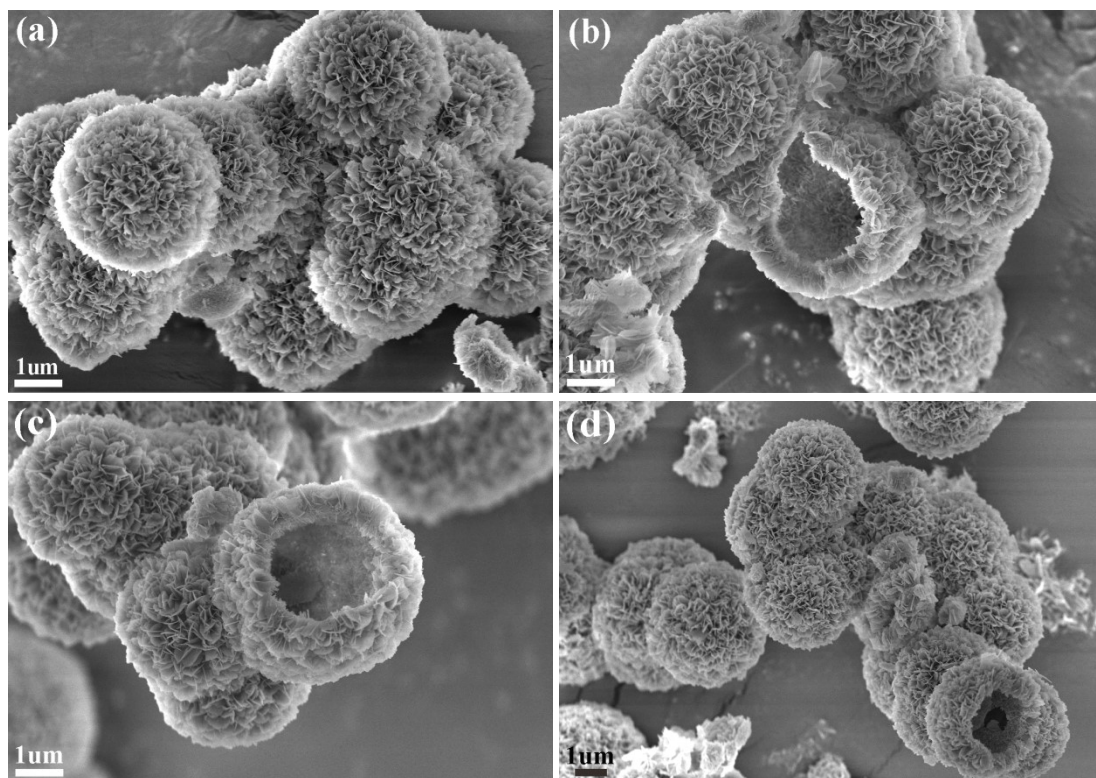
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**Fig. S1** SEM (a), FESEM (b), TEM (c) and schematic image (d) of NA- $\text{Al}_2\text{O}_3$  support.



**Fig. S2** FESEM of calcined Ni/(NA-Al<sub>2</sub>O<sub>3</sub>) catalysts: (a) 3%-Ni/(NA-Al<sub>2</sub>O<sub>3</sub>); (b) 5%-Ni/(NA-Al<sub>2</sub>O<sub>3</sub>); (c) 10%-Ni/(NA-Al<sub>2</sub>O<sub>3</sub>); (d) 20%-Ni/(NA-Al<sub>2</sub>O<sub>3</sub>).

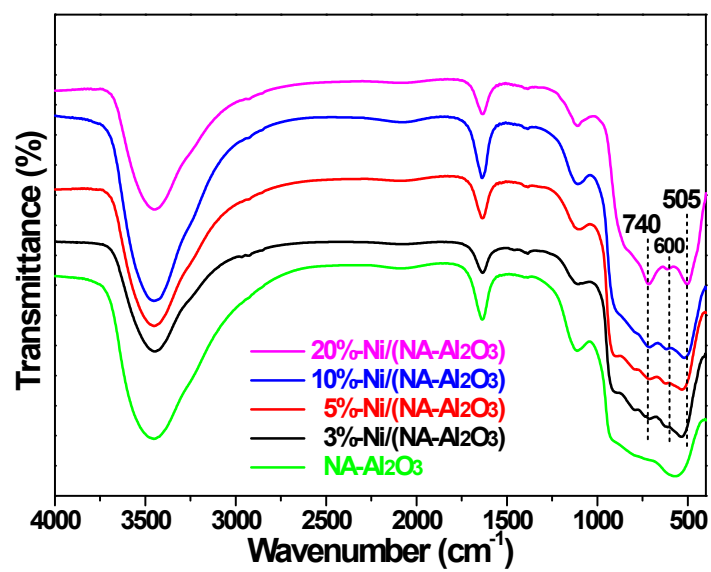


Fig. S3 FT-IR spectra of NA-Al<sub>2</sub>O<sub>3</sub> support and calcined Ni/(NA-Al<sub>2</sub>O<sub>3</sub>) catalysts.

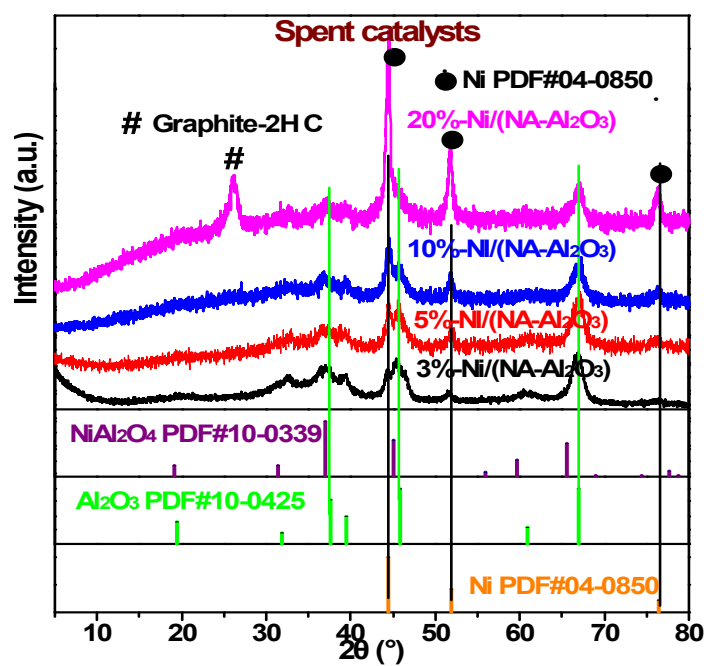


Fig. S4 XRD patterns of spent Ni/(NA-Al<sub>2</sub>O<sub>3</sub>) catalysts.

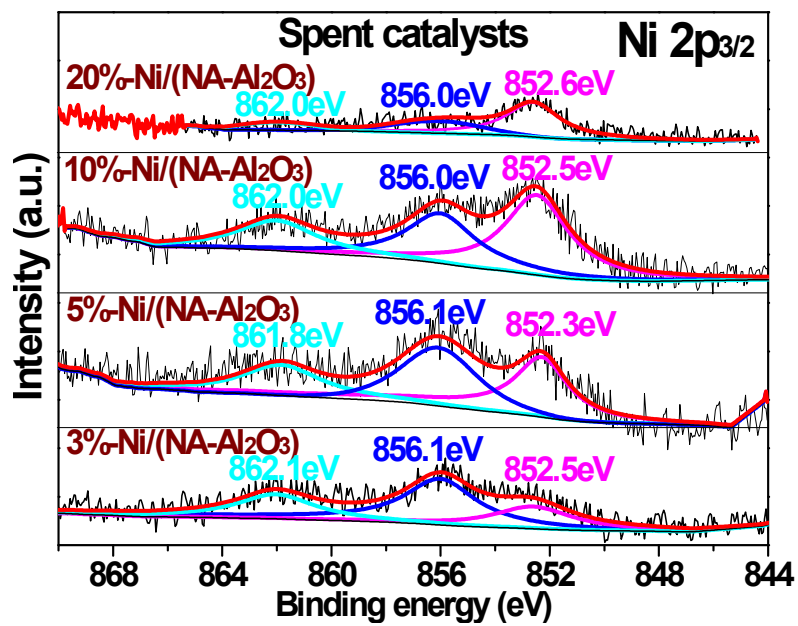


Fig. S5 XPS spectra of Ni 2p<sub>3/2</sub> region of spent Ni/(NA-Al<sub>2</sub>O<sub>3</sub>) catalysts.

**Table S1** Textural properties of NA-Al<sub>2</sub>O<sub>3</sub> support and Ni/(NA-Al<sub>2</sub>O<sub>3</sub>) catalysts with various Ni loadings.

| Catalysts                                   | $S_{\text{BET}}$ (m <sup>2</sup> /g) | Pore volume (cm <sup>3</sup> /g) | Mean pore diameter (nm) |
|---|--------------------------------------|----------------------------------|-------------------------|
| NA-Al <sub>2</sub> O <sub>3</sub>           | 203.5                                | 0.73                             | 8.3                     |
| 3%-Ni/(NA-Al <sub>2</sub> O <sub>3</sub> )  | 129.9                                | 0.70                             | 19.7                    |
| 5%-Ni/(NA-Al <sub>2</sub> O <sub>3</sub> )  | 128.7                                | 0.69                             | 20.9                    |
| 10%-Ni/(NA-Al <sub>2</sub> O <sub>3</sub> ) | 123.3                                | 0.66                             | 23.9                    |
| 20%-Ni/(NA-Al <sub>2</sub> O <sub>3</sub> ) | 93.4                                 | 0.62                             | 25.4                    |

**Table S2** Ni crystallite size, Ni particle size and surface composition of the spent Ni/(NA-Al<sub>2</sub>O<sub>3</sub>) catalysts.

| Catalysts                                   | Ni crystallite size <sup>a</sup> | Ni particle size <sup>b</sup> | Ni particle           | Ni <sup>0</sup> /(Ni <sup>0</sup> +Ni <sup>2+</sup> ) <sup>d</sup> |
|---|----------------------------------|-------------------------------|-----------------------|--|
|   | (nm)                             | (nm)                          | size growth           |  |
|   | Spent                            | Spent                         | rate (%) <sup>c</sup> | Spent  |
| 3%-Ni/(NA-Al <sub>2</sub> O <sub>3</sub> )  | 11.1                             | 11.6                          | 352                   | 0.31   |
| 5%-Ni/(NA-Al <sub>2</sub> O <sub>3</sub> )  | 17.4                             | 18.2                          | 294                   | 0.51   |
| 10%-Ni/(NA-Al <sub>2</sub> O <sub>3</sub> ) | 19.0                             | 20.1                          | 218                   | 0.59   |
| 20%-Ni/(NA-Al <sub>2</sub> O <sub>3</sub> ) | 23.7                             | 24.3                          | 219                   | 0.72   |

<sup>a</sup> Calculated from XRD patterns by Scherrer equation.

<sup>b</sup> Obtained from TEM images by making statistics of particle distribution.

<sup>c</sup> Obtained by dividing the Ni particle size of spent catalyst by Ni particle size of reduced catalyst obtained from TEM results.

<sup>d</sup> Surface element composition obtained from XPS results.