

## Supplementary Information

### Catalyst design: Counter anion effect on Ni nanocatalysts anchored on hollow carbon spheres

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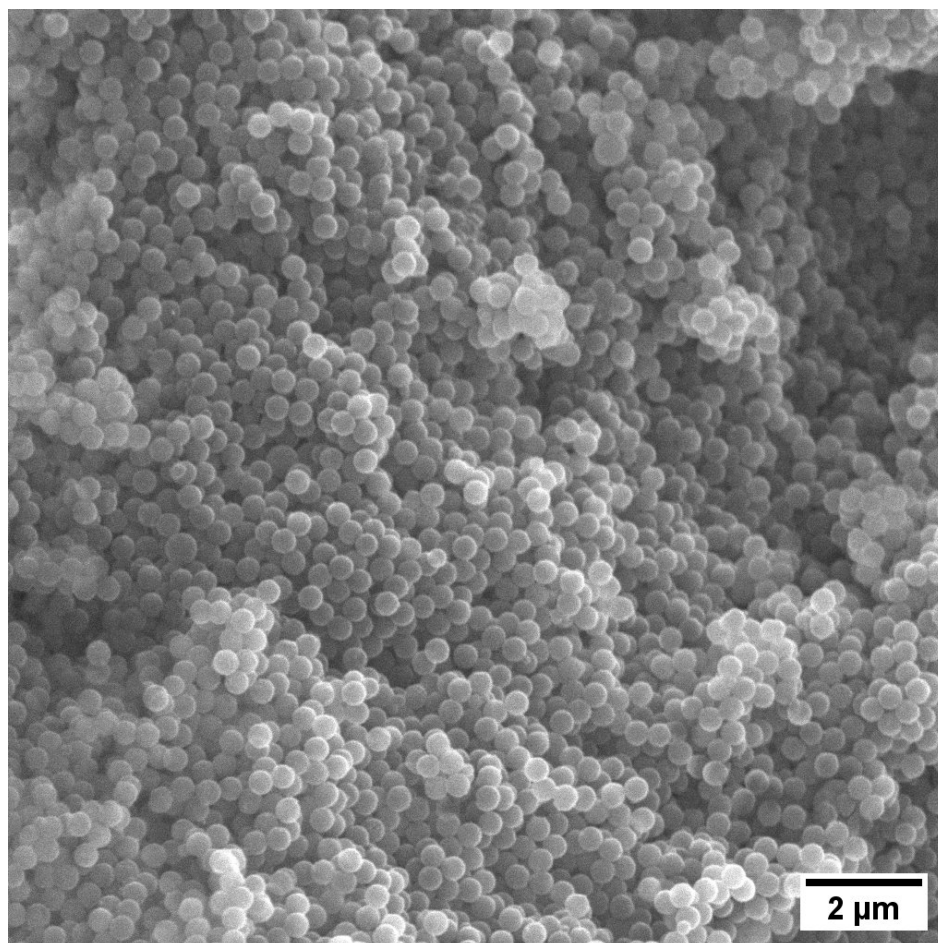
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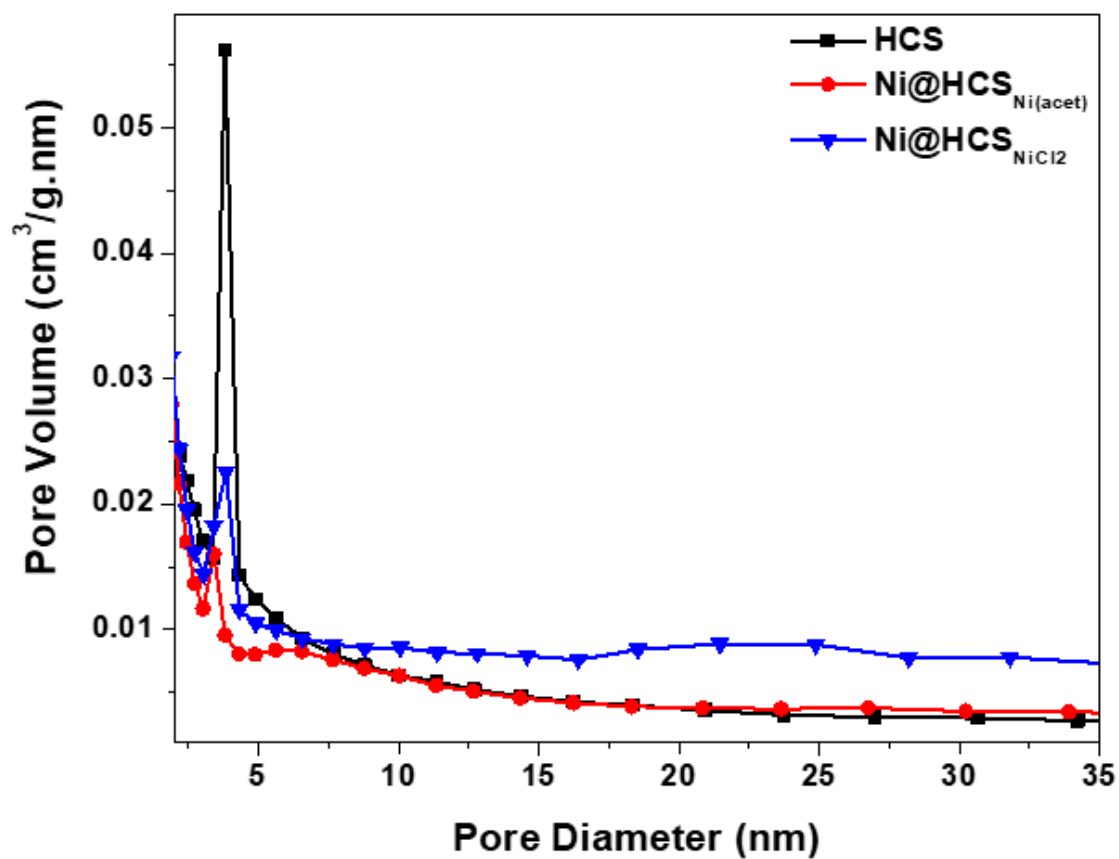
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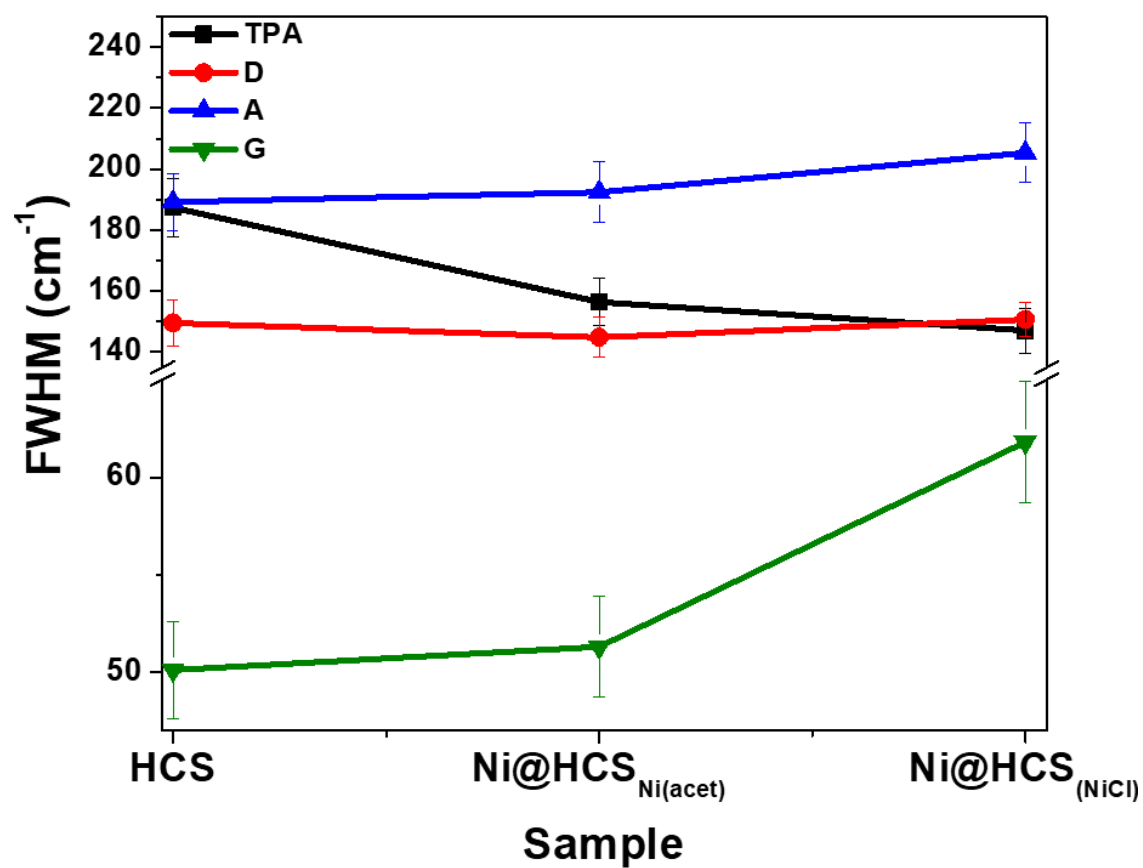
## Results



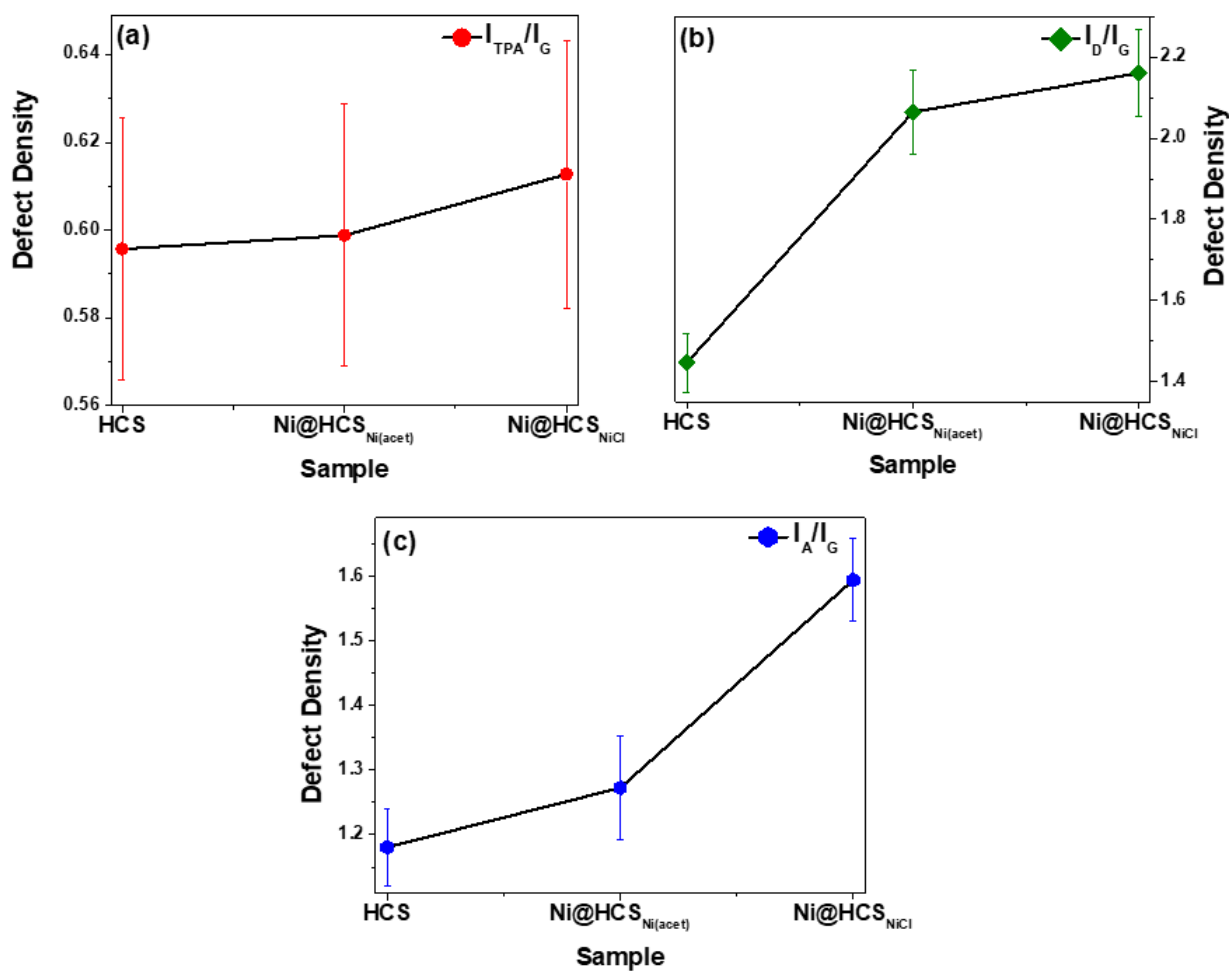
**Figure S1:** SEM micrographs of the PSS template.



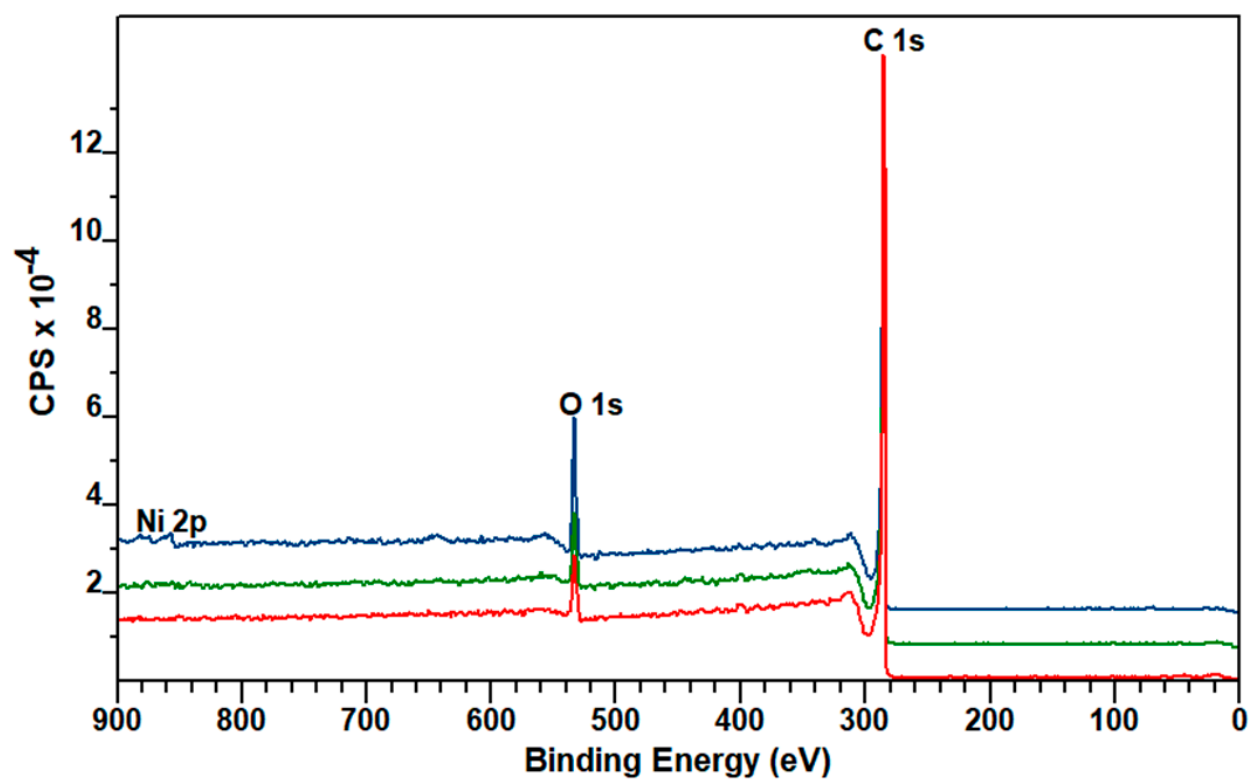
**Figure S2:** Pore size distributions of the pristine HCSs and Ni@HCSs nanocatalysts.



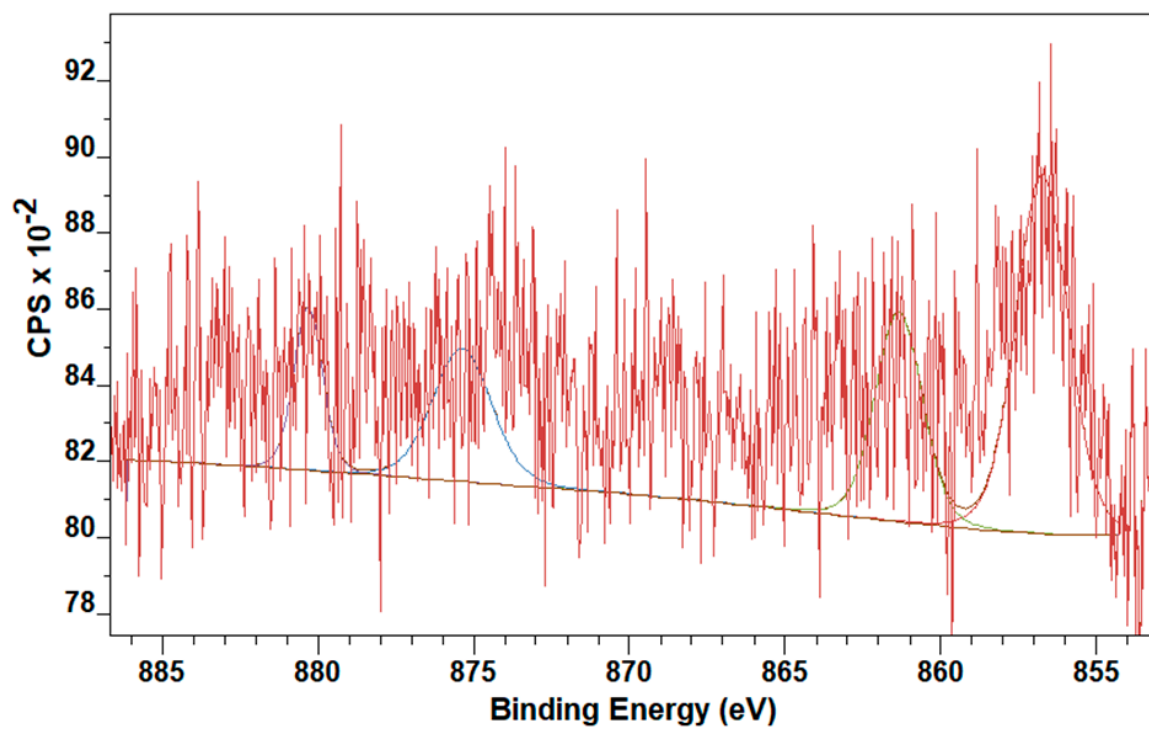
**Figure S3:** Peak broadening for all Raman-active bands for the pristine HCSs and nanocatalysts.



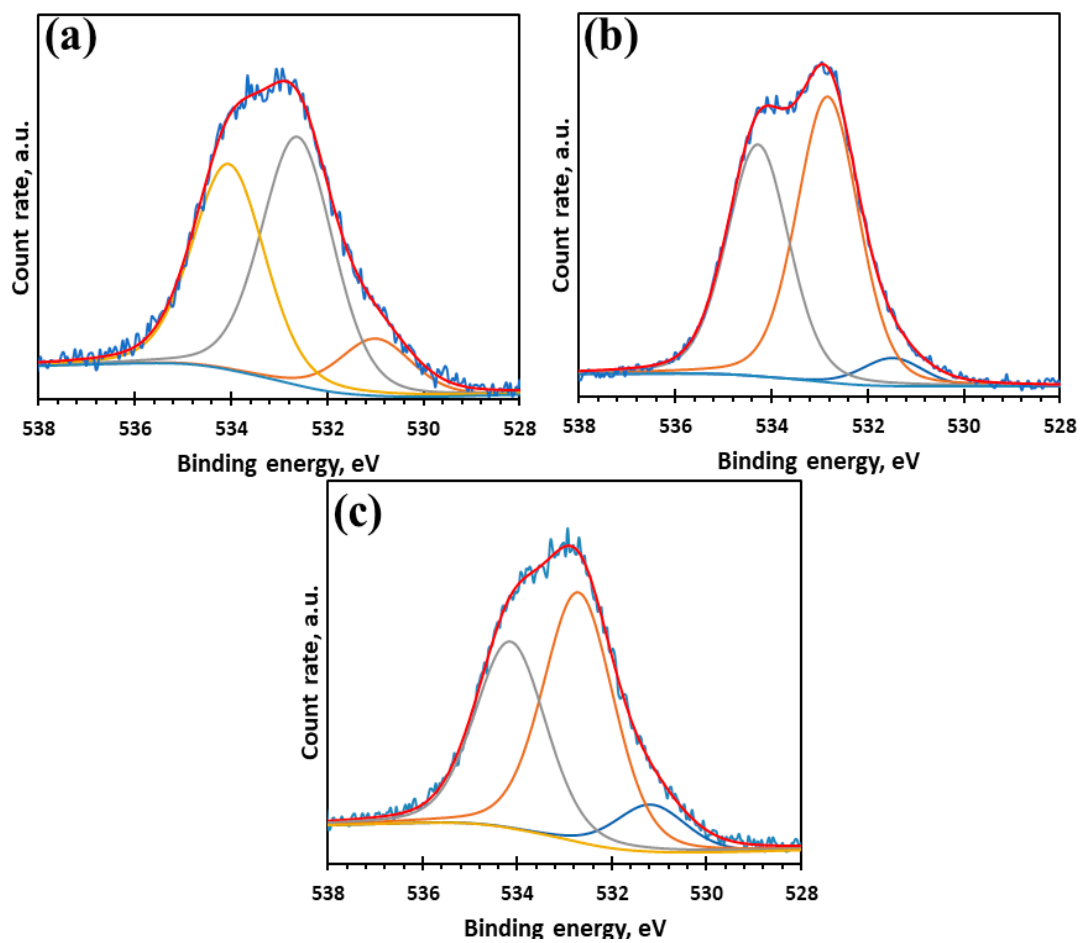
**Figure S4:** Defect density ratios (a)  $I_{TPA}/I_G$ , (b)  $I_D/I_G$  and (c)  $I_A/I_G$  of the pristine and Ni@HCSs samples.



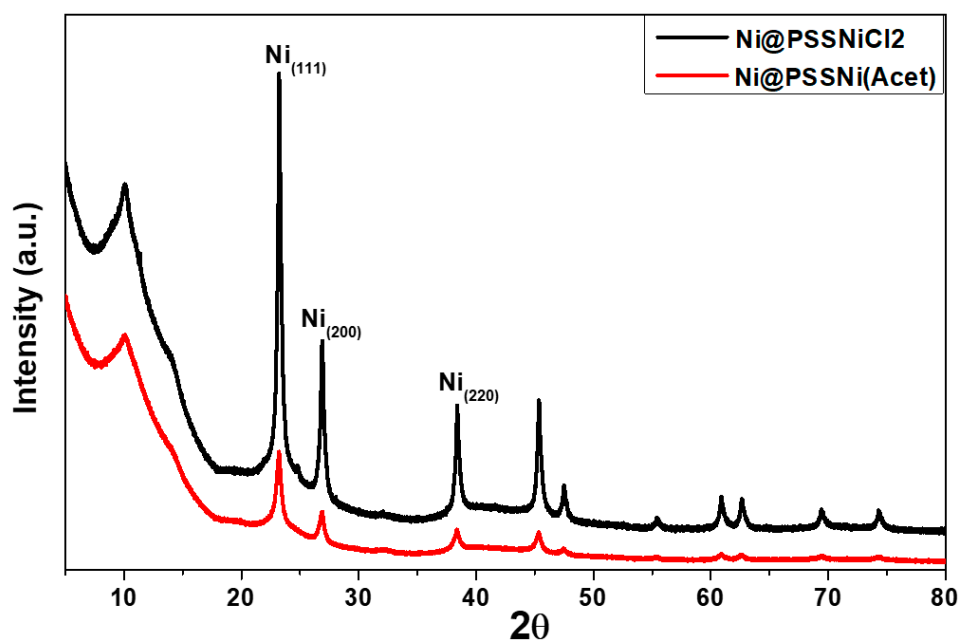
**Figure S5:** Survey XPS spectra of pristine HCSs (red), Ni@HCSsNi(acet)<sub>2</sub> (blue), and Ni@HCSsNiCl<sub>2</sub> (green) nanocatalysts



**Figure S6:** Deconvoluted Ni 2p spectrum of Ni@HCS<sub>NiCl2</sub> nanocatalysts.



**Figure S7:** Deconvoluted O1s spectra of (a) pristine HCSs, (b) Ni@HCSsNi(acet)<sub>2</sub>, and (c) Ni@HCSsNiCl<sub>2</sub> nanocatalysts.



**Figure S8:** XRD patterns of the Ni nanoparticles on the PSS templates prior to RF coating.

**Table S1:** Morphological parameters based on TEM micrographs

Sample	Size (nm)				
	Diameter	Cavity	Shell	Ni nanoparticle	
				TEM	XRD
HCSs	342 ± 17	327 ± 16	10 ± 2.1	-	-
Ni@HCSs <sub>NiCl2</sub>	332 ± 25	281 ± 21	23 ± 4.7	12 ± 1.9	10.9
Ni@HCSs <sub>Ni(acet)</sub>	326 ± 25	245 ± 19	42 ± 6.9	6.4 ± 1.2	8.6



**Table S2:** Thermal stability properties of pristine and Ni@HCSs samples

<i>Sample</i>	<i>Onset Temp (°C)</i>	<i>Decomp. Temp. (°C)</i>			<i>% Residue</i>
		(i)	(ii)	(iii)	
<i>HCSs</i>	568.1		642.7		0.76
<i>Ni@HCSs<sub>Ni(acet)</sub></i>	452.2	489.3	582.6	630.5	6.84
<i>Ni@HCSs<sub>NiCl2</sub></i>	426.1	484.5	552.5	592.9	10.2