**Supporting Information**

**Supporting Figures**



**Figure S1**. Schematic illustration of electrochemical etching of silicon wafers used to prepare MSS materials.

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**Figure S2**. Plan view SEM images for (a) 20n50μ and (b) 50n50μ MSS materials. Scale bar: 200 nm.

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**Figure S3**. TEM image of 20 nm pore size MMS. For the TEM imaging, MMS samples are fractured ultrasonication (50T, VWR International) for 4 hours in ethanol. The pore morphology of these 20 nm pore size sample is apparent in the TEM images.

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**Figure S4**. SEM images of 50 nm pore size MMS after fractured by ultrasonication. The pore morphology of 50 nm pore size samples is clearly observed in the SEM images.

**Supporting Tables**

**Table SI**. Nitrogen adsorption analysis of the prepared MSS materials.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Material | Surface area  (m2/g) | Pore Volume  (cm3/g) | Pore diameter  /adsorption branch  (nm) | Pore diameter  /desorption branch  (nm) | BJH (nm) a |
| 20n50μ | 358.0 | 1.39 | 16.2 | 16.2 | 14.05 |
| 20n5μ | 398.6 | 1.96 | 19.8 | 19.9 | 15.36 |
| 50n50μ | 459.5 | 3.39 | 28.9 | 30.0 | 23.95 |
| 50n5μ | 529.1 | 2.98 | 20.6 | 22.2 | 22.58 |

a BJH adsorption average pore diameter.

**Table SII**. Temperature dependence of the chemical shift and linewidth of Xe peaks for 20n50μ material (20 nm pore size, 50 μm particle size).

|  |  |  |
| --- | --- | --- |
| Temp (K) | Absorbed Xe peak | |
| Chemical Shift (ppm) | Linewidth (ppm) |
| 373 | 52.35 | 10.96 |
| 353 | 56.00 | 13.8 |
| 333 | 62.30 | 12.89 |
| 313 | 71.35 | 11.7 |
| 300 | 73.27 | 9.22 |
| 293 | 79.39 | 10.41 |
| 273 | 90.54 | 12.15 |
| 253 | 100.13 | 9.5 |
| 233 | 111.46 | 8.5 |
| 213 | 118.49 | 7.77 |
| 193 | 127.45 | 7.04 |
| 173 | 134.21 | 7.86 |

**Table SIII**. Temperature dependence of the chemical shift and linewidth of Xe peaks for 20n5μ material (20 nm pore size, 5 μm particle size).

|  |  |  |
| --- | --- | --- |
| Temp (K) | Absorbed Xe peak | |
| Chemical Shift (ppm) | Linewidth (ppm) |
| 373 | 38.64 | 7.40 |
| 353 | 43.85 | 8.31 |
| 333 | 50.16 | 10.5 |
| 313 | 59.11 | 11.33 |
| 300 | 62.58 | 10.6 |
| 293 | 70.25 | 14.89 |
| 273 | 80.67 | 13.89 |
| 253 | 95.38 | 14.07 |
| 233 | 108.17 | 12.42 |
| 213 | 119.59 | 10.60 |
| 193 | 130.09 | 9.96 |
| 173 | 143.57 | 13.16 |

**Table SIV**. Temperature dependence of the chemical shift and linewidth of Xe peaks for 50n50μ material (50 nm pore size, 50 μm particle size).

|  |  |  |
| --- | --- | --- |
| Temp (K) | Absorbed Xe peak | |
| Chemical Shift (ppm) | Linewidth (ppm) |
| 373 | 32.98 | 21.83 |
| 353 | 38.19 | 25.30 |
| 333 | 45.77 | 27.68 |
| 313 | 54.72 | 10.69 |
| 300 | 60.75 | 9.22 |
| 293 | 64.3 | 9.41 |
| 273 | 74.46 | 11.79 |
| 253 | 89.81 | 16.26 |
| 233 | 102.32 | 14.35 |
| 213 | 114.93 | 14.53 |
| 193 | 122.79 | 13.54 |
| 173 | 129.91 | 13.34 |

**Table SV**. Temperature dependence of the chemical shift and linewidth of Xe peaks for 50n5μ material (50 nm pore size, 5 μm particle size).

|  |  |  |
| --- | --- | --- |
| Temp (K) | Absorbed Xe peak | |
| Chemical Shift (ppm) | Linewidth (ppm) |
| 373 | 24.03 | 5.12 |
| 353 | 27.13 | 5.48 |
| 333 | 31.88 | 6.49 |
| 313 | 38.74 | 7.49 |
| 300 | 42.48 | 6.58 |
| 293 | 48.69 | 8.68 |
| 273 | 61.58 | 9.06 |
| 253 | 76.92 | 11.24 |
| 233 | 95.93 | 12.01 |
| 213 | 112.10 | 10.23 |
| 193 | 124.25 | 9.04 |
| 173 | 131.83 | 9.39 |