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# Highly Flexible and Transferable Supercapacitors with Ordered Three-dimensional $MnO_2$/Au/$MnO_2$ Nanospikes Arrays

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## Supplementary Information

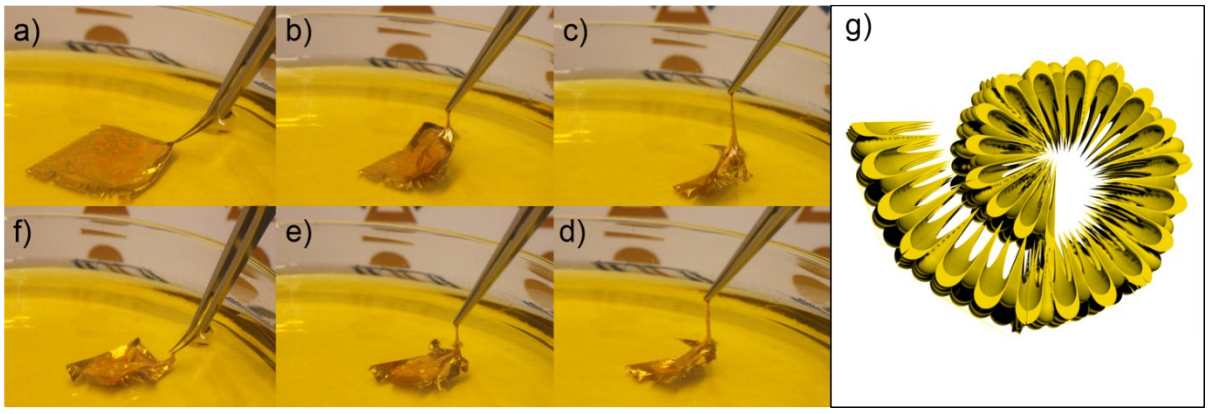


**Figure S1.** Mechanical robustness test of free-standing Au NSPs film with tweezers. a-c) Free-standing Au NSPs film wraps itself up upon leaving the surface of solution. d-f) The film unwraps itself naturally when placed back to the solution. g) Schematic image shows the point contact between NSPs.

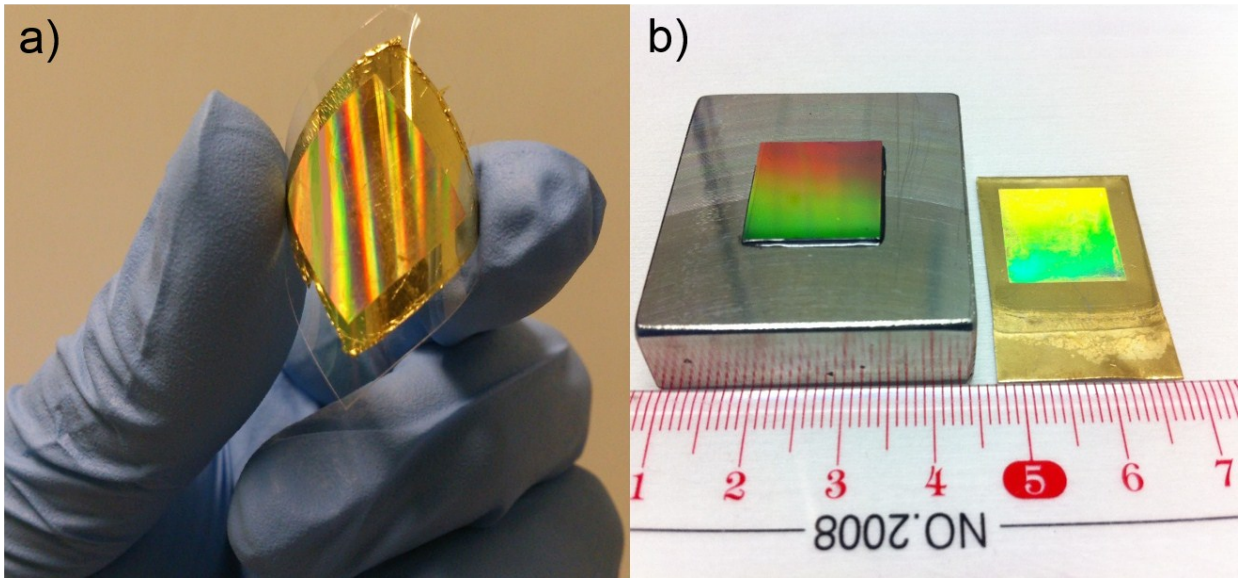


**Figure S2.** a) Photograph of free-standing Au NSPs film transfered onto PC. b) Si mold and as-fabricated Au NSPs with the footprint area of 1.5 cm × 1.5 cm.

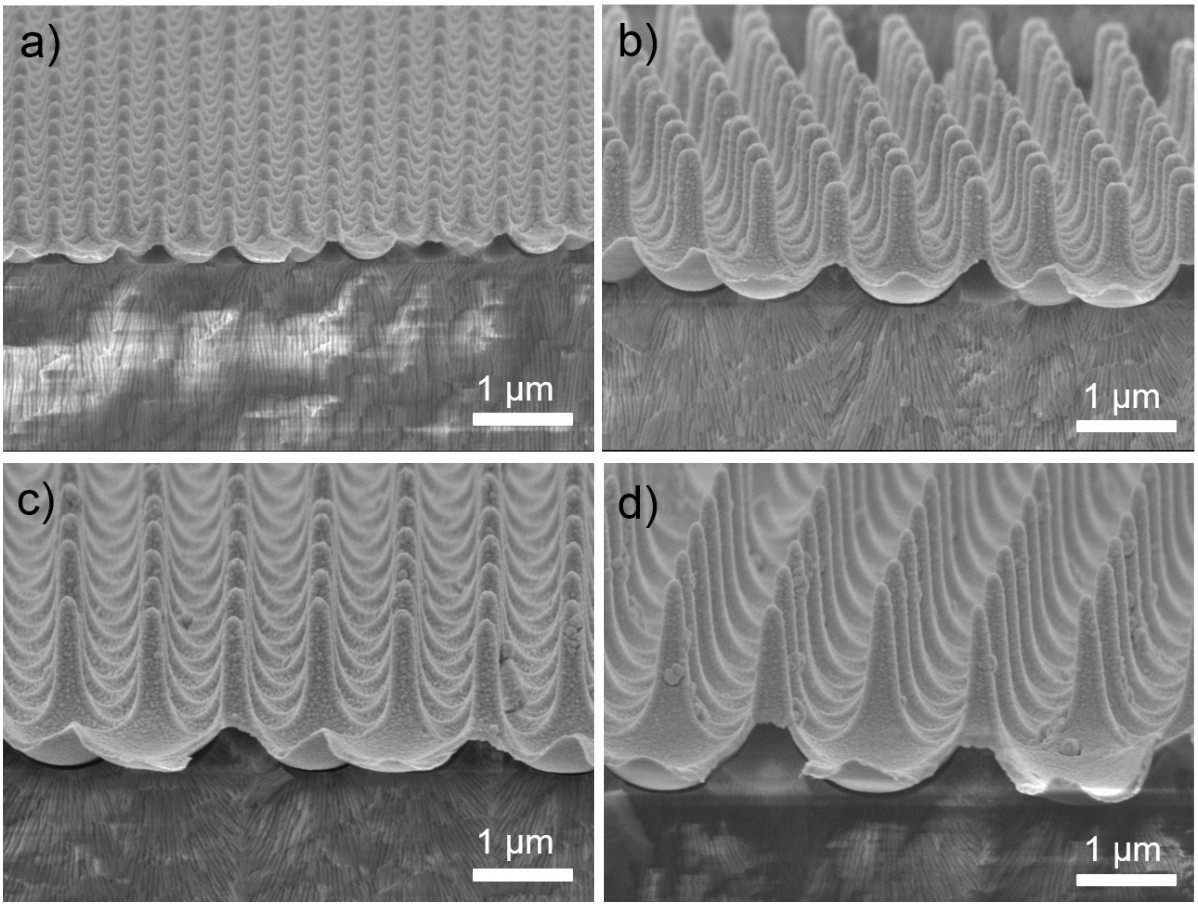


**Figure S3.** SEM images of Au NSPs with different pitches. a) 0.5 µm. b) 1 µm. c) 1.2 µm. d) 1.5 µm.

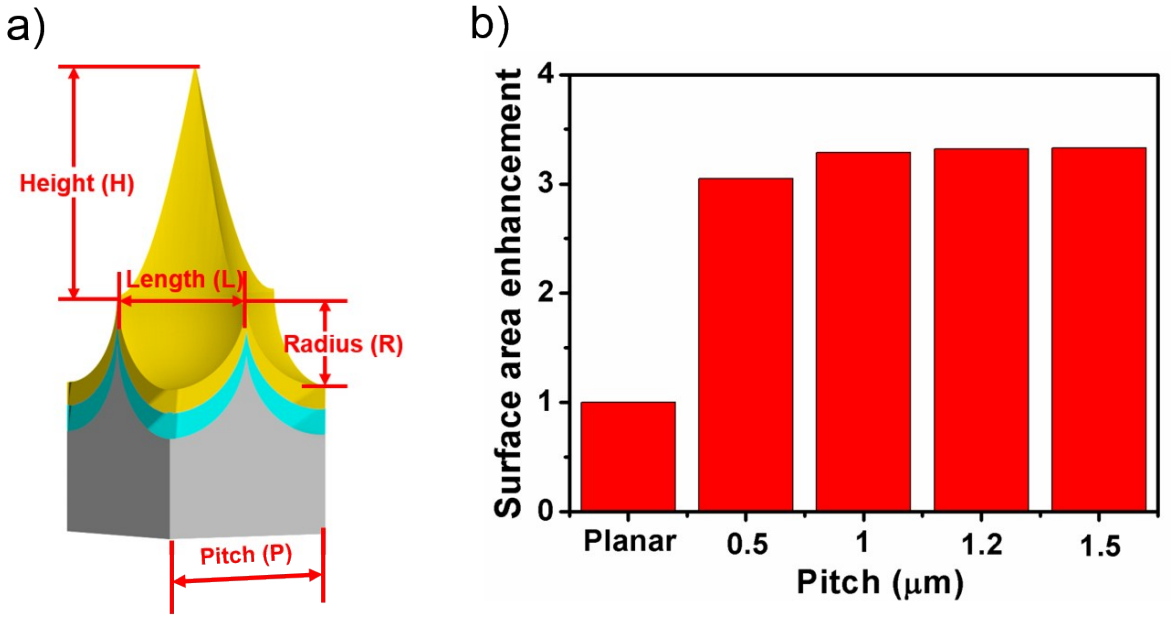


**Figure S4.** a) Structural schematic for surface area calculation. b) Surface area enhancement with different pitches of 0.5 μm, 1 μm, 1.2 μm, 1.5 μm as compared with planar structure.

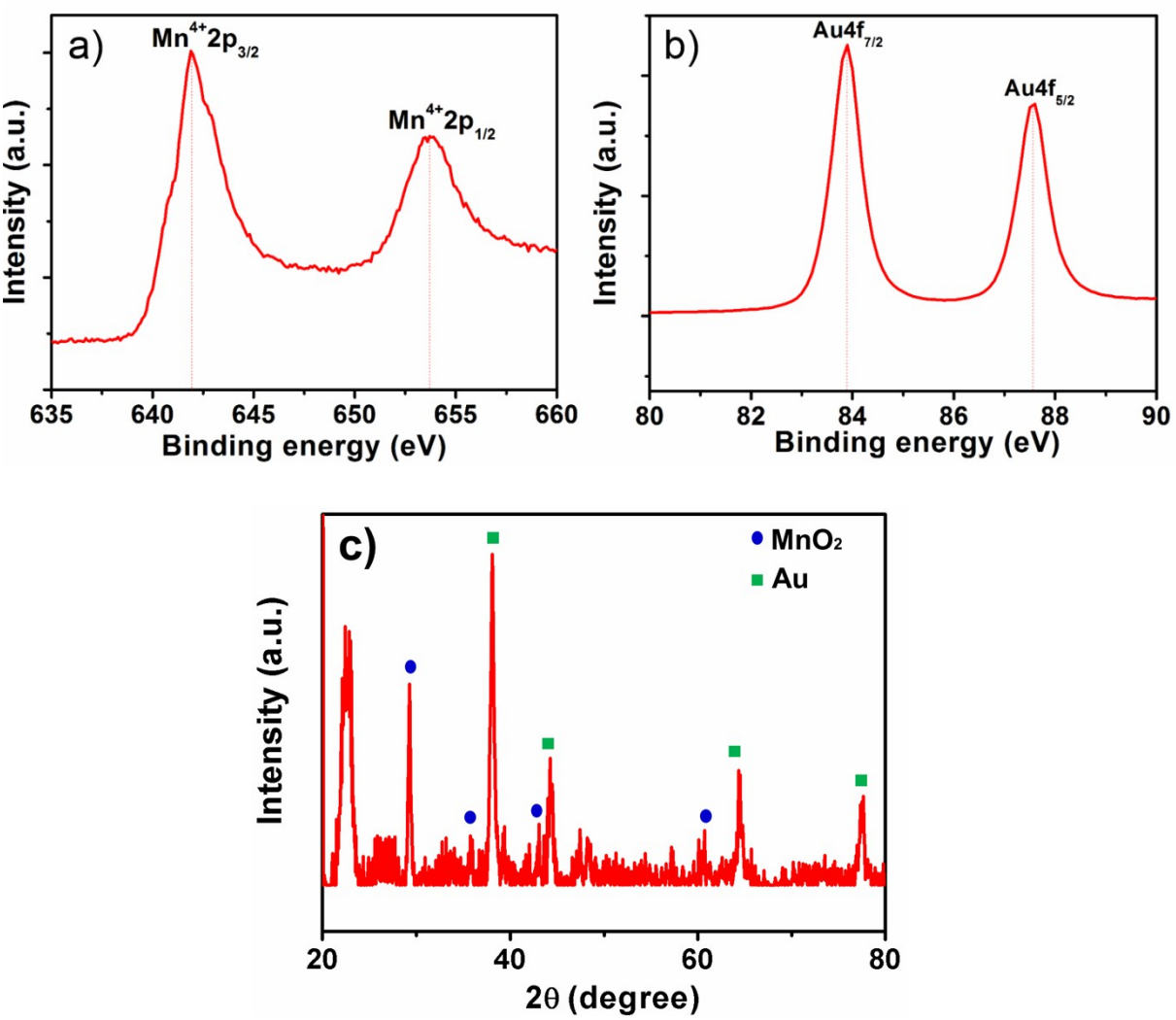


**Figure S5.** a) XPS spectra of Mn 2p, two peaks are at 641.9 eV (Mn $2p_{3/2}$) and 653.7 eV (Mn $2p_{1/2}$). b) XPS spectra of Au 4f, the peaks at 83.6 eV (Au $4f_{7/2}$), and 87.25 eV (Au $4f_{5/2}$) are from gold metal achieved by sputtering deposition. c) Wide angle of XRD patterns of $MnO_2$ and Au.

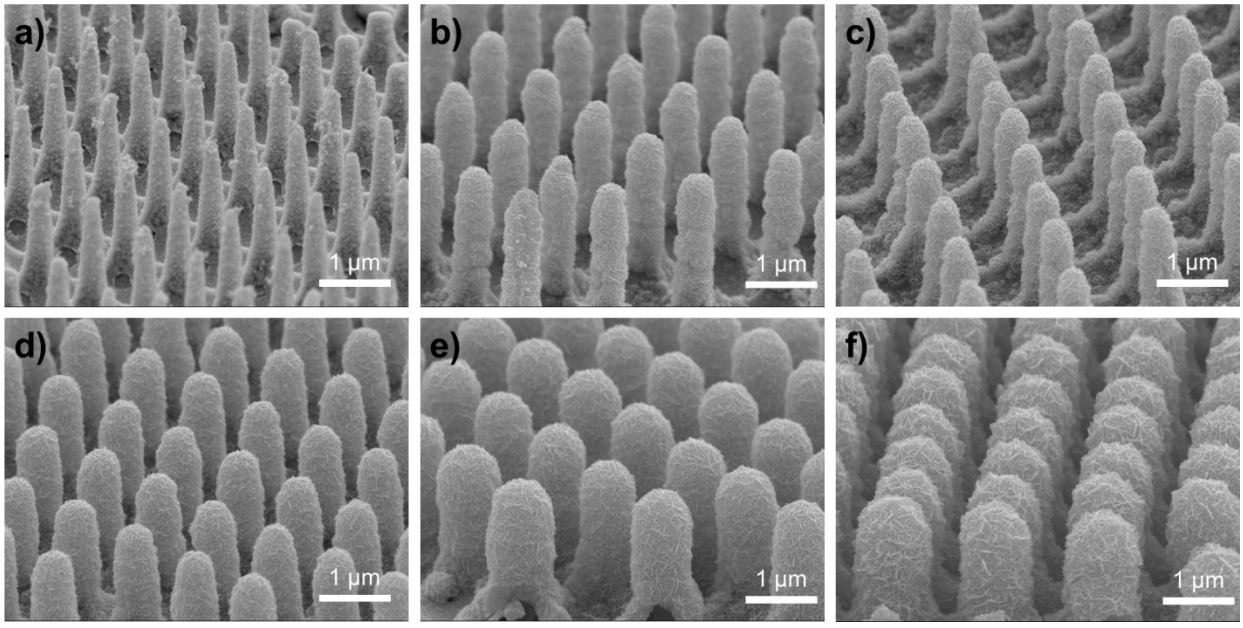


**Figure S6.** a-f) SEM images of MAMNSPs electrodes with different electrodeposition time (5 s, 15 s, 30 s, 45 s, 60 s, and 120 s).

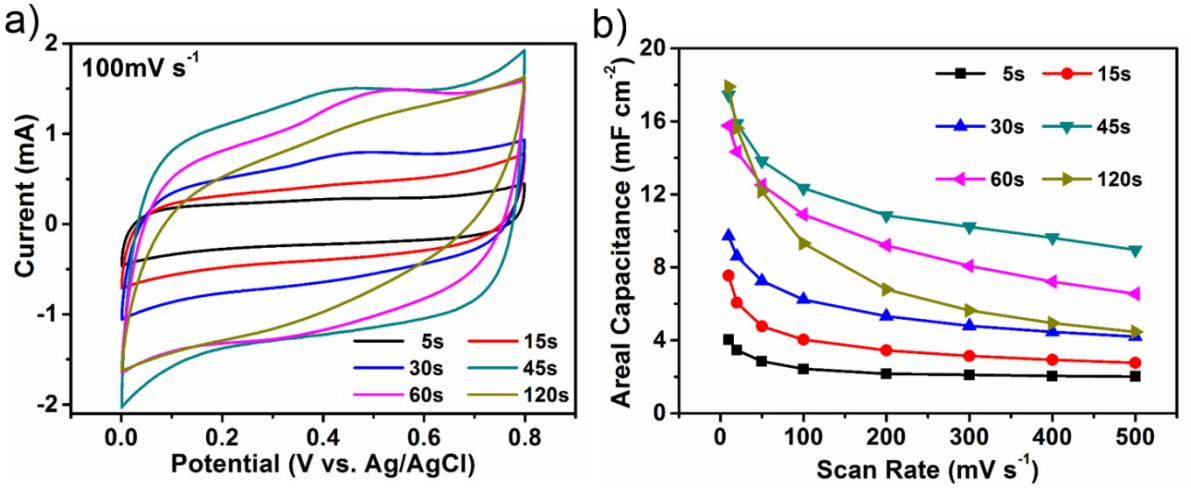


**Figure S7.** a) CV curves of MAMNSPs electrode with different deposition time (5 s - 120 s) at the scan rate of 100 mV $s^{-1}$. b) Areal capacitance as a function of scan rate with different deposition time.

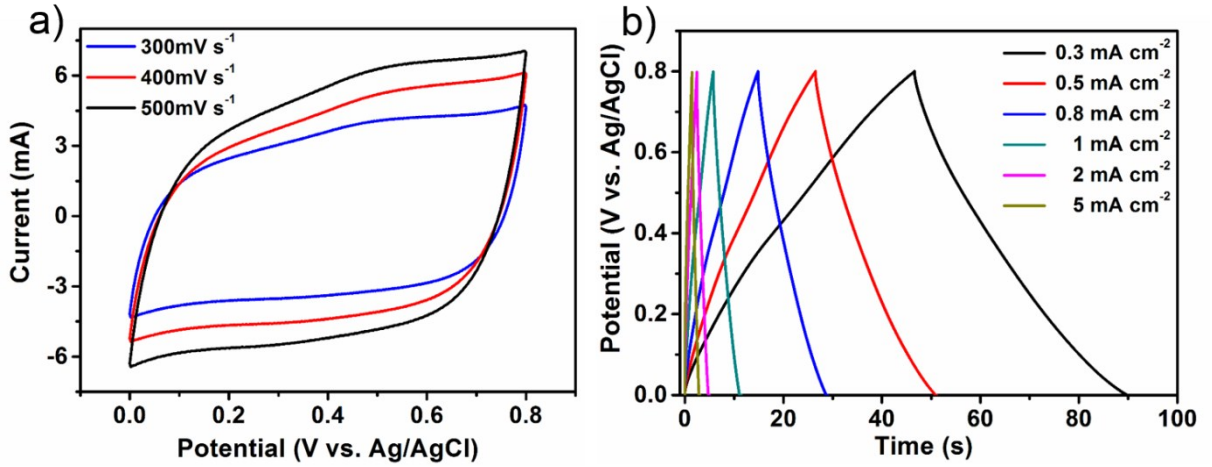


**Figure S8.** a) CV curves of MAMNSPs electrode with 45 s deposition at different scan rate (300 mV $s^{-1}$ - 500 mV $s^{-1}$). b) GCD curves of MAMNSPs electrode with 45 s deposition at different current density (0.3 mA $cm^{-2}$ - 5 mA $cm^{-2}$).

**Surface Area Calculation**

As shown in Figure S4a, the geometry of Au NSPs consists of a tetrahedron and fourfold one-eighth sphere. Surface area ($S$ $cm^{-2}$) of Au NSPs in an 1 $cm^{-2}$ projected area can be calculated using the following equation:

$$S = \frac{4}{P^2}\left(\frac{LH}{2} + \frac{4\pi R^2}{8}\right) \quad (1)$$

Where $P$ is the bottom center-center distance between two neighbouring NSPs, $H$ is the height from peak to the valley of each NSP, $L$ is the length between two neighbouring valleys of NSPs. $R$ is the radius of the sphere. The value of $H$ and $R$ are measured by SEM, and $L$ is achieved by theoretical calculation using the following equations:

$$L = 0.707\ P \quad (2)$$