Supporting Information

Silicon Nanowires and Nanotrees: Elaboration and Optimization of new 3D Architectures for High Performance on-chip Supercapacitors

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Gold mass deposited by electroless plating:

A very rough estimation of the gold mass deposited on the samples was conducted by carefully weighting at least 25 (1 cm²) samples, before and after gold plating. The time between the measurements was kept minimal (< 2 hours) in order to reduce any risks of contamination. The experiment was reproduced at least two times for each gold concentration. The gold quantity deposited using the 10, 2 and 1 mM gold plating bathes, estimated with this method, gives respectively gold masses in the order of 35 μ g.cm⁻² ± 2 μ g



Figure S1: HR-STEM micrographs of a 2 mM 50 μm long Si-NW displaying single crystalline structure



Figure S2: a) 10 mM, b) 2 mM and c) 1 mM, 50 µm long Si-NWs diameter distributions



Figure S3: High resolution mosaic SEM cross section view of: **a)** 10 mM SiNWs coated with 10 mM electroless gold, **b)**, **c)**, **d)**, **e) and f)** the corresponding 10 mM/ 10 mM SiNTrs with respectively 5, 12, 21, 49 and 72 μ m long branches. All the mosaic pictures are using the same scale.



Figure S4: a) High resolution mosaic SEM cross section view of 10 mM /10 mM SiNTrs with 50 μ m long trunks and 21 μ m long branches; **b**, **c**, **d**, **e**) and **f**): branches diameter distribution corresponding respectively to zones A, B, C, D and E on Figure S4 a).

Figure S5 a, b) SEM views of 2 mM 50 μ m long trunks coated with 10 mM electroless gold: **a)** 45 ° SEM top view and **b)** 90 ° cross section of a cleaved sample; **c)** Cross section mosaic SEM print of 2 mM / 10 mM Si-NTrs with 50 μ m long trunks and 21 μ m branches.



Figure S6: Electrochemical characterization of 10 mM, 50 μ m long trunks sample in EMI-TFSI: **a)** cyclic voltammetry curves at different scan rate in three electrodes cell; **b)** capacitance values derived from the capacitive current at -0.5 V from **a)**; **c**, **d**, **e**, **f**): symmetric 1 cm² sandwich device characterization: **c)** galvanostatic charge/discharge cycles at different current densities; **d)** capacitance retention during galvanostatic charge/discharge cycling at ±1 mA.cm⁻² with a 4 V electrochemical window, **e)** Nyquist impedance spectroscopy plot at OCP between 10 mHz and 400 kHz (inset showing the high frequency region), **f)** Phase angle of the impedance versus frequency.