Supplementary Material for

Study of morphological change of silver/carbon fiber composites and optimization for high-performance electrochemical electrodes

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Keywords: silver sphere; carbon fiber sheet; nanosphere synthesis; electrochemical electrode; supercapacitor; electrothermal process

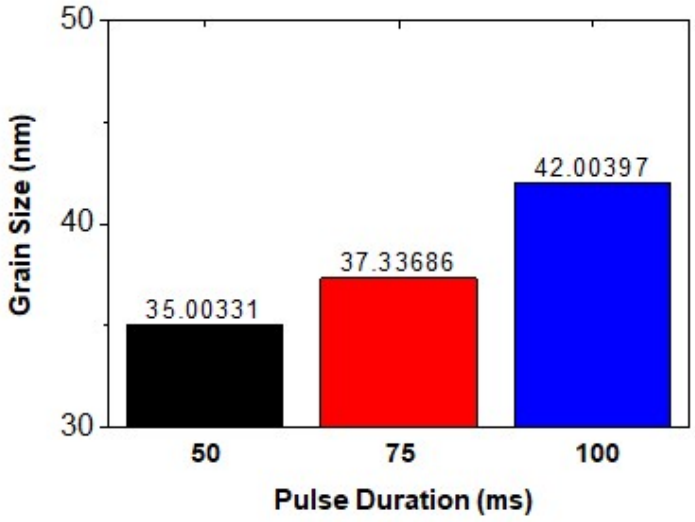

Figure S1. Variation of the average grain size of Ag particles. The average grain size was analyzed using Debye Scherrer theory with (111) plane peak, as given in the XRD spectra **(Figure 3 (f))**.

Debye Scherrer equation is expressed as follows in equation (1),

$$D = \frac{0.9\lambda}{\beta\cos\theta} \qquad (1)$$

where λ is the wavelength of the X-ray, β is the full width at half maximum (FWHM), and θ is the Bragg angle.

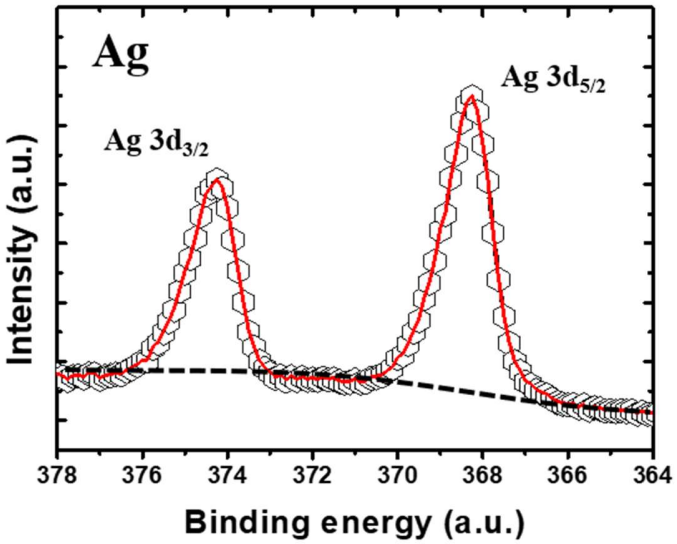

Figure S2. X-ray photoelectron spectroscopy (XPS) spectra of Ag-CF hybrid composites. Narrow scan of Ag $3d_{3/2}$, Ag $3d_{5/2}$ peaks, obtained from Ag-CF hybrid composites fabricated by ETP under a 1500 W power, 75 ms pulse duration, and 3 times of the pulse.

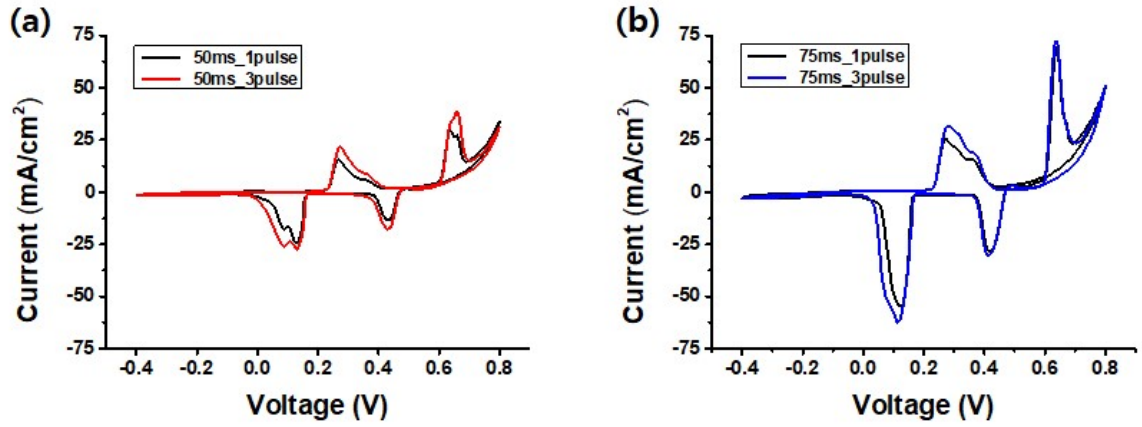

Figure S3. Cyclic voltammetry (CV) curves of Ag/CFs electrodes obtained by applying different numbers of pulses with 50 and 75 ms duration at scan rate of 20 mV/s.

Specific areal capacitance was calculated using a following equation:

$$C = \frac{\int IV \; dV}{2\mu mW}$$

where C is the specific capacitance, I is the current in the CV test, V is the Potential in the CV test, μ is the scan rate, m is the area of the sample and W is the voltage window.

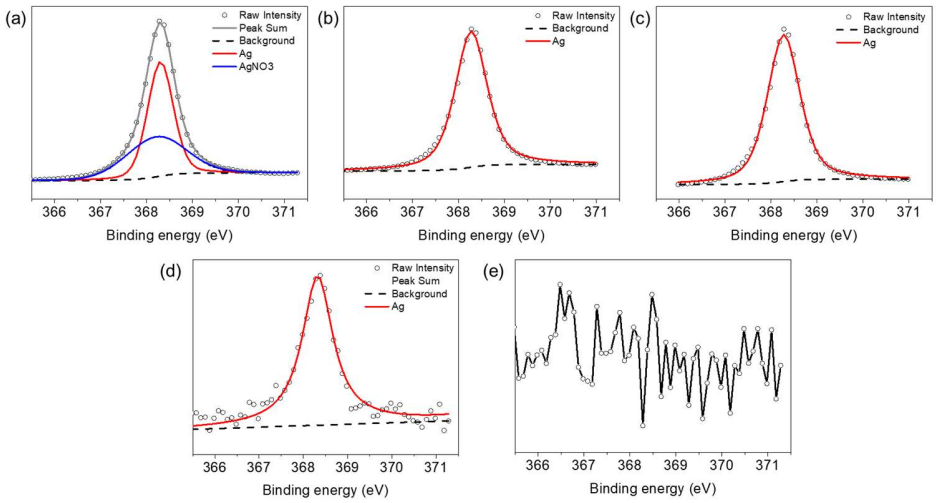

Figure S4. X-ray photoelectron spectroscopy (XPS) spectra at Ag 3d 5/2 of Ag-CF hybrid composites made by single ETP pulse with different duration of (a) 25 ms, (b) 50 ms, (c) 75 ms, (d) 100 ms and (e) 125 ms.

Except 25 ms and 125 ms, all raw data was fitted well with only Ag. In case of 25 ms, the data was fitted with the peak intensity of Ag at 368.3 eV and $AgNO_3$ at 368.2 eV[1, 2]

Table S1. Comparison of supercapacitance performance utilizing Ag-carbon based hybrid materials as active materials.

active materials	Electrolyte	Silver morphology	Measurement condition	Capacitance	CDC	Retention (%)	Ref.
Ag/carbon fiber	KOH 5 M	sphere	5 mV/s	13 F/cm^2	1000	98	this work
PANI/Ag_2O-Ag	$Na_2S_2O_3$ 0.5 M	porous sphere	0.4 A/g	160 F/g	1000	-	[3]
Ag/activated carbon	KOH 6 M	irregularly shaped spheroid	5 mV/s	3.288 F/cm^2	10000	130	[4]
Ag/porous carbon	KOH 6 M	irregularly shaped spheroid	0.5 A/g	323.8 F/g	4000	93.2	[5]
Ag/carbon sphere	KOH 3 M	agglomerated sphere	1 mA/cm^2	0.421 F/cm^2	2000	96	[6]
Ag/rGO/cotton	NaOH 0.5 M	irregularly shaped spheroid	5 mV/s	426 F/g	1000	126	[7]

Abbreviation: CDC, charge-discharge cycle number

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