Supplementary Information (SI) for Journal of Materials Chemistry C.
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Electronic Supplementary Information (ESI)

Zinc oxide-decorated MIL-53(Al)-derived porous carbon for supercapacitor devices

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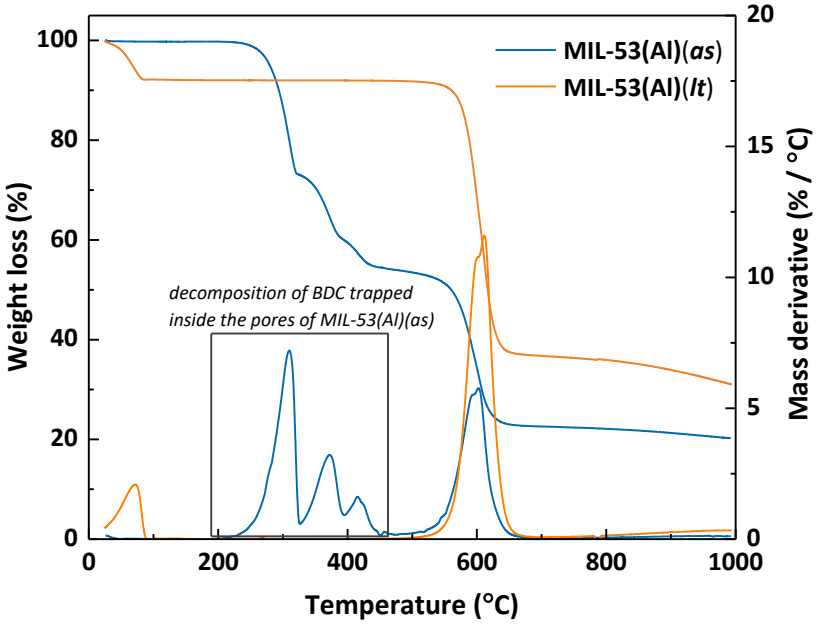

Figure S1. TGA profiles measured in Ar flow for the un-impregnated (*as*) and (*lt*) MIL-53(Al) samples.

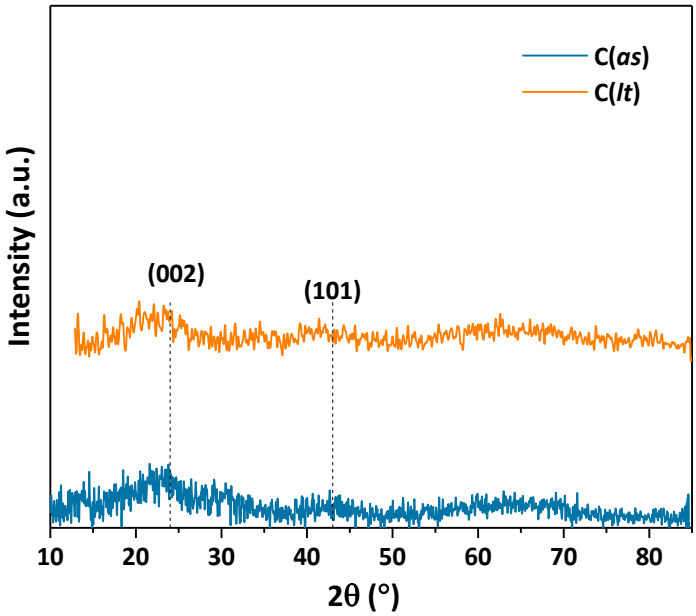

Figure S2. XRD patterns of the un-impregnated (*as*) and (*lt*) MIL-53(Al)-derived carbon samples.

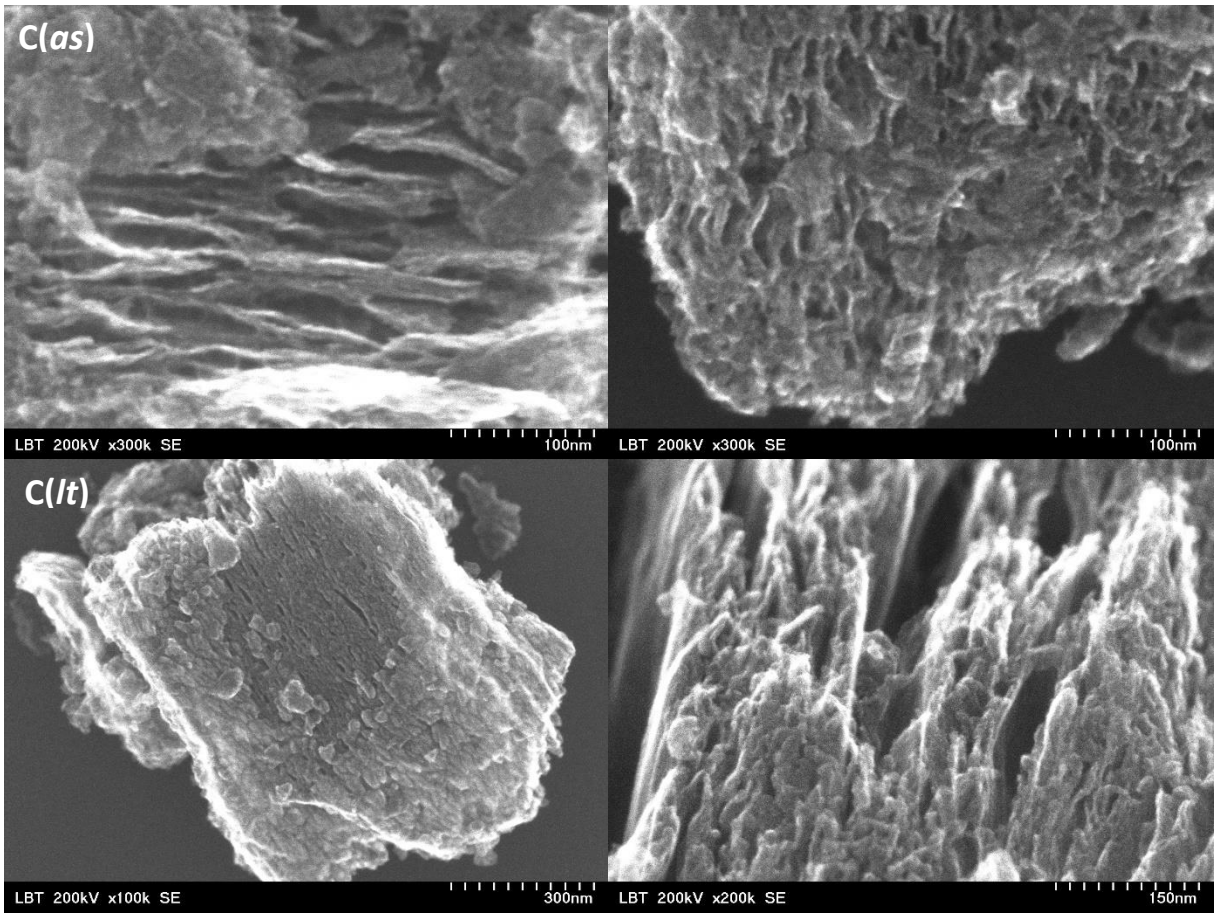

Figure S3. SEM images of the MIL-53(Al)-derived C samples.

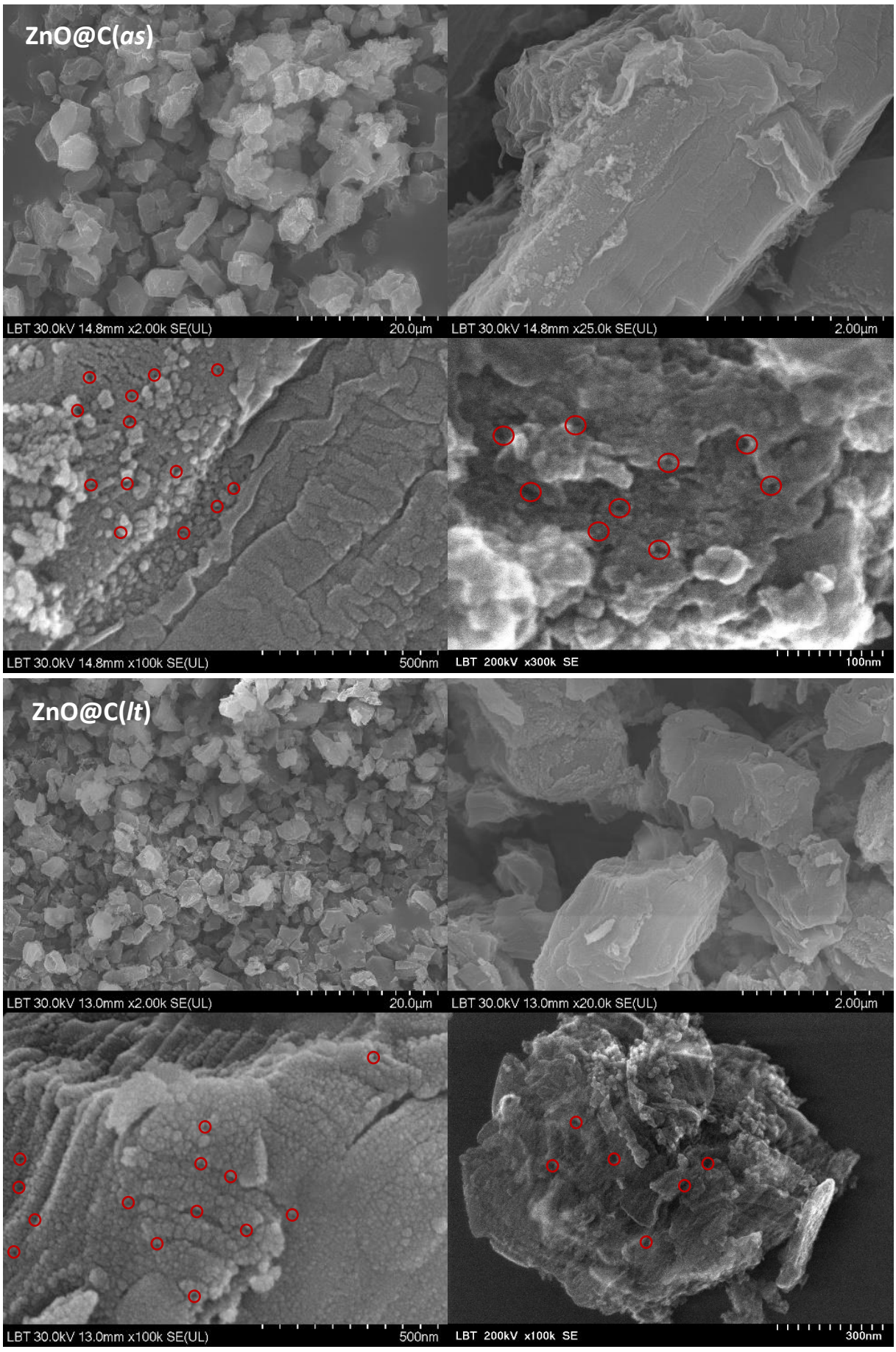

Figure S4. SEM images at different magnifications for the ZnO@C MIL-53(Al)-derived composites (red circles randomly mark small pores within the samples).

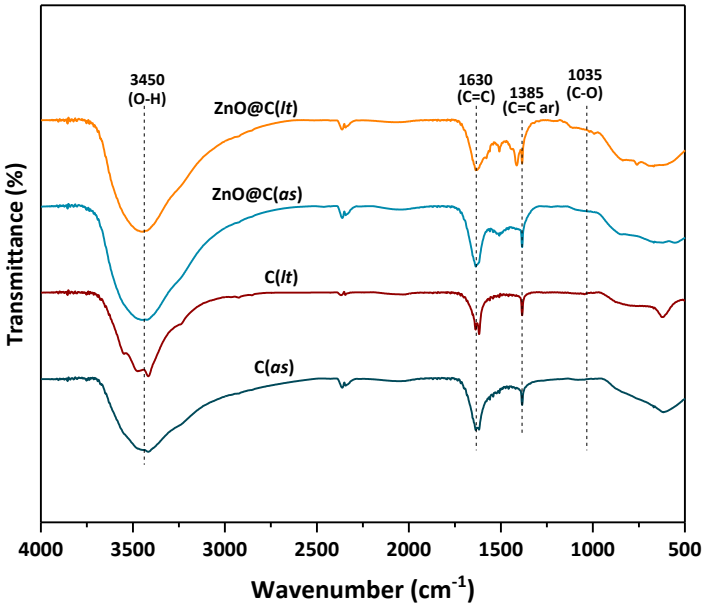

Figure S5. FTIR spectra of the ZnO@C MIL-53(Al)-derived composites.

Methods

The equations used to determine the specific capacitance (F/g), energy density (Wh/kg), and power density (W/kg) of a supercapacitor are provided below. In this study, specific capacitance (F g^{-1}) was calculated from the CV curves, while specific capacity (mA h g^{-1}) was derived from the GCD data. These two parameters represent different aspects of the electrochemical performance of the ZnO@C electrode material. Detailed calculation methods for both parameters are provided below. The specific capacitance values ($C_{p,}$ *F/g*) were calculated from the CV curves using Equation 1, where *I* (mA) represent the applied current, d*V* (V) is the operated voltage window, *v* (mV/s) is the applied scan rate, and *m* (g) is the mass of the electrode material used.

$$C_p = \frac{\int_{V_1}^{V_2} I(V)dV}{2mv\Delta V} \quad (1)$$

The energy density and power density for the prepared electrodes were calculated according to Equations 2 and 3, respectively.

$$E_D = \frac{0.5 * C_p * \Delta V^2}{3.6} \quad (2)$$

$$P_D = \frac{E_D}{(\Delta t/3600)} \quad (3)$$

where, C_p is the specific capacitance (F/g), ΔV (V) is the maximum potential window, E_D is the energy density, and Δt is the discharging time.

The electrochemical properties, along with all other results, were obtained using the software (EC-Lab) of the BioLogic VMP 300 electrochemical device.

Table S1. Fitted equivalent circuit parameters of the ZnO@C-based SCs.

	Equivalent Circuit					
	ZnO-sym	**ZnO@C(*as*)-sym**	**ZnO@C(*lt*)-sym**	**ZnO-asym**	**ZnO@C(*as*)-asym**	**ZnO@C(*lt*)-asym**
R_1	5	9.4×10^{-9}	19.5	1000	1.5	1.3
R_2	57221	0.2×10^{42}	0.1×10^{36}	100	10.3×10^{-9}	43659
R_3	473032	2.8×10^{-3}	--	10	157.5	3735
R_4	31481	1156	--	1	224264	--
C_1	--	--	--	1×10^{-6}	0.12×10^{-6}	--
C_2	--	--	--	--	--	0.1×10^{-3}
C_3	23.5×10^{-6}	25073	--	--	--	--
C_4	69.8×10^{-6}	42.5×10^{-6}	--	1×10^{-9}	1.14×10^{-9}	--
Q_1	--	--	--	--	--	--
Q_2	--	--	0.11×10^{-3}	1×10^{-6}	28.35×10^{-6}	--
Q_3	--	--	30.2×10^{-6}	--	--	14.9×10^{-6}
Q_4	--	--	--	--	--	46.9×10^{-6}
A1	--	--	--	--	--	--
A2	--	--	0.46	0.7	0.69	--