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Electronic Supplementary Information

On the origin of the high capacitance of carbon derived from seaweed with *apparent* low surface area

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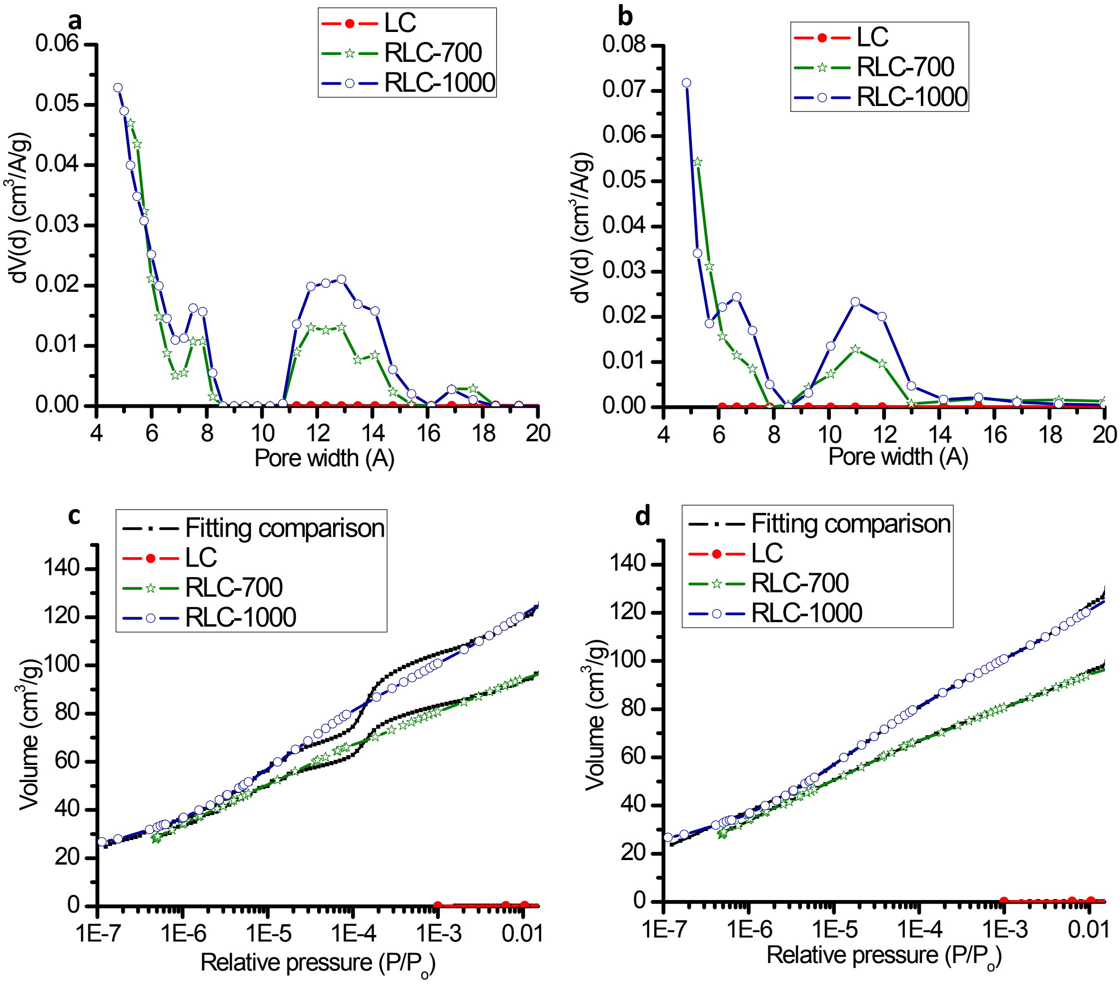

Fig. S1 Comparison of the QSDFT and NLDFT models for micropore size analysis: (a) NLDFT N_2 pore size distributions (slit pore geometry), (b) QSDFT N_2 pore size distributions (slit pore geometry), (c) NLDFT N_2 fitting comparison ($4.8 \times 10^{-7} \leq P/P_o \leq 0.01$) and (d) QSDFT N_2 fitting comparison ($4.8 \times 10^{-7} \leq P/P_o \leq 0.01$), for the LC, RLC-700 and RLC-1000 series, as indicated. Note that, the sharp minimum observed in the pore size distributions is mostly attributed to a mathematical artifact because the chosen NLDFT models may not describe all the subtleties of a real carbon surface. QSDFT models provide a better representation of the surface properties, including surface roughness features.[1-2]

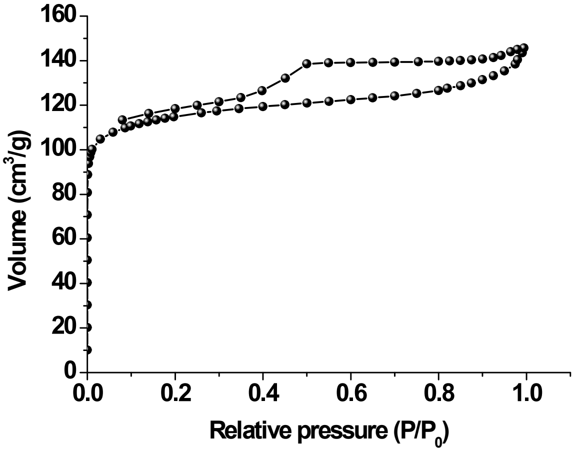

Fig. S2 N_2 sorption isotherm of RLC-700 with 5 wt% PTFE measured at 77 K.

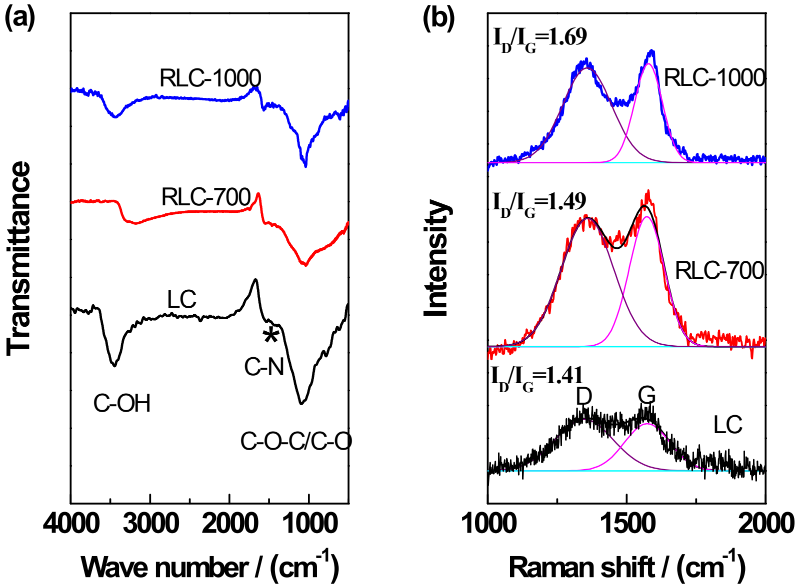

Fig. S3 FT-IR (a) and Raman (b) spectra of LC, RLC-700 and RLC-1000.

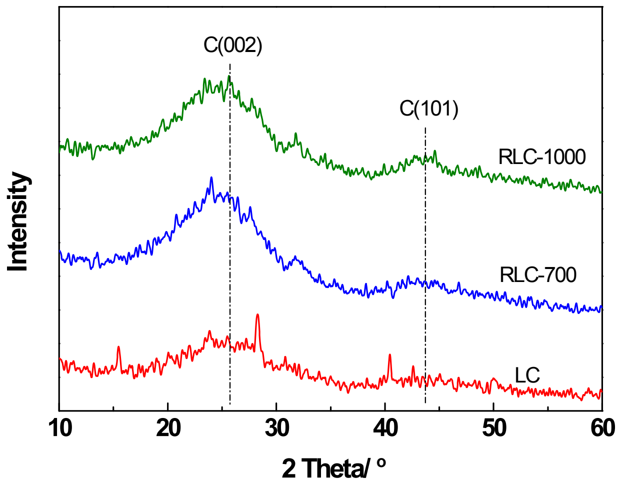

Fig. S4 Wide-angle XRD patterns of LC, RLC-700 and RLC-1000.

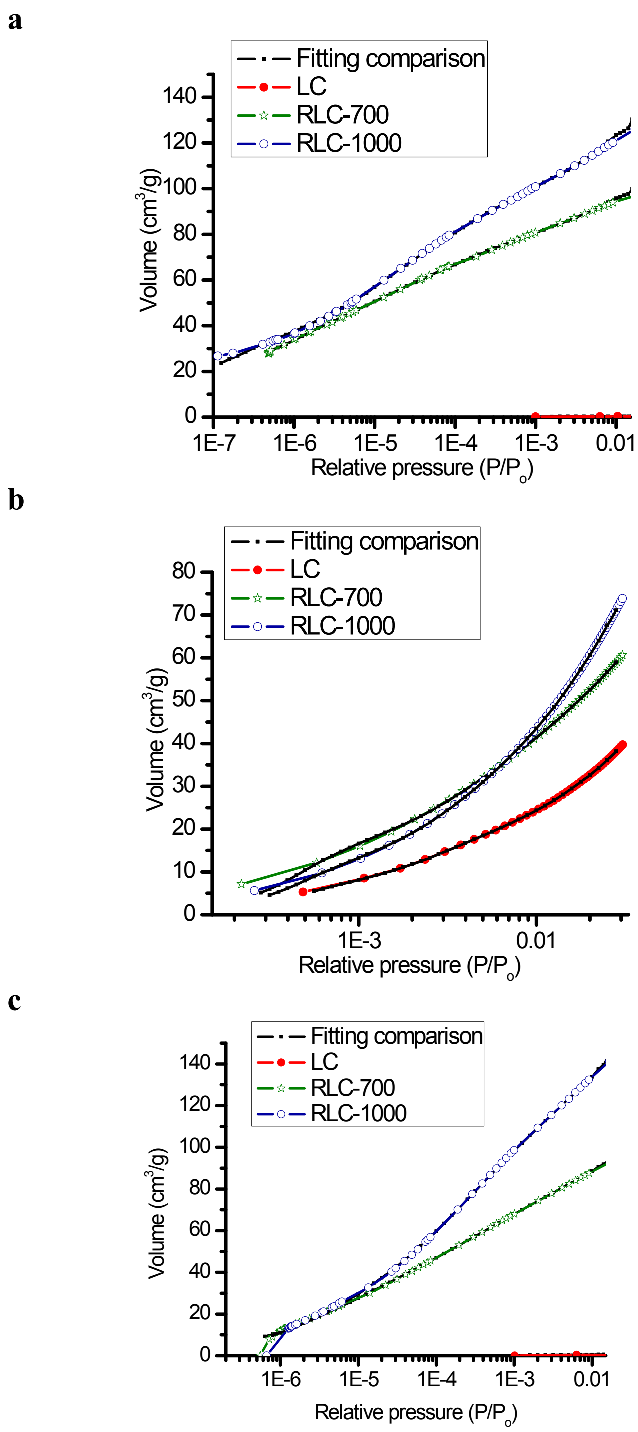

Fig. S5 (a) QSDFT fitting comparison of the N_2 sorption isotherms measured at 77 K ($5.2\text{x}10^{-7} \leq P/P_o \leq 0.01$) (model of slit pore geometry, equilibrium model), (b) NLDFT fitting comparison of the CO_2 sorption isotherms measured at 273 K ($2.2\text{x}10^{-4} \leq P/P_o \leq 0.03$), and (c) QSDFT fitting comparison of the Ar sorption isotherms measured at 87 K ($5.3\text{x}10^{-7} \leq P/P_o \leq 0.01$) (model of slit pore geometry, equilibrium model) for the LC, RLC-700 and RLC-1000 series, as indicated (see Fig. 2 for respective isotherms and pore size distributions).

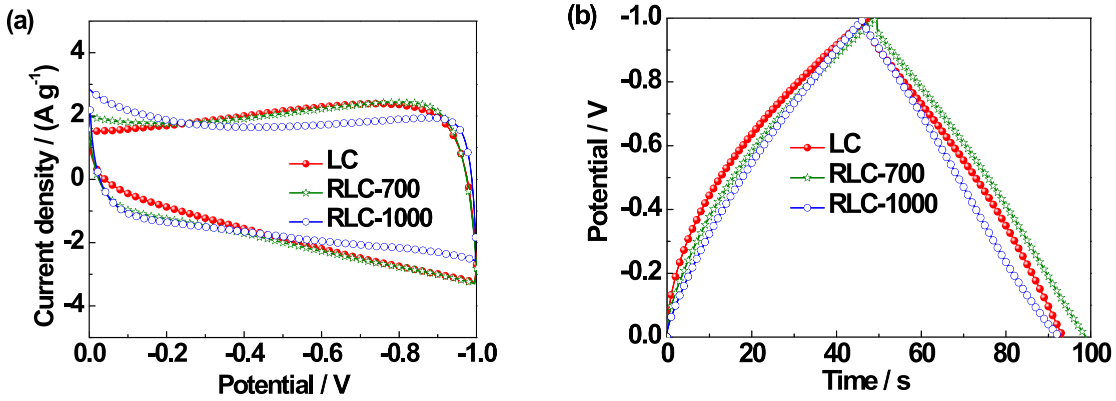

Fig.S6 Capacitive performance of laver-based carbons: (a) Cyclic voltammograms at scan rate of 20 mV s^{-1}; (b) Galvonostatic charge-discharge curves at 2 A g^{-1}.

Tables

Table S1: Physicochemical parameters derived from the physisorption isotherms.

	Sample	**BET $[\mathrm{m}^2\,\mathrm{g}^{-1}]$**	**Cumulative surface area $[\mathrm{m}^2\,\mathrm{g}^{-1}]$[a]**	**Cumulative pore volume $[\mathrm{cm}^3\,\mathrm{g}^{-1}]$ [b]**	**Pore width [Å]**	**DFT model fitting errors [%][e]**
N_2	LC	~2	1.6 (1.3)	0	-[c]	2.75
	RLC-700	396	567 (516)	0.25 (0.15)	4.8, 10.8	0.39
	RLC-1000	542	714 (639)	0.35 (0.20)	4.8, 10.9	0.66
CO_2	LC	-[d]	- (410)	- (0.12)	3.5, 4.8, 8.2	0.23
	RLC-700	-[d]	- (616)	- (0.17)	3.5, 5, 8.2	2.49
	RLC-1000	-[d]	- (750)	- (0.23)	3.5, 5, 8.2	1.25
Ar	LC	~2	3.6	0.01 (-)	-[c]	6.1
	RLC-700	352	514 (451)	0.25 (0.11)	4.5, 10	0.53
	RLC-1000	543	728 (636)	0.37 (0.21)	4.8, 10.9	0.66

a) Values between parentheses refer to the respective cumulative QS- or NL-DFT *micropore* surface area (slit geometry); in $\mathrm{m}^2\,\mathrm{g}^{-1}$. These values are given as indication of the specific surface area attributed to micropores. b) The values between parentheses refer to the respective cumulative QS- or NL-DFT micropore volume (slit geometry); in $\mathrm{cm}^3\,\mathrm{g}^{-1}$. c) no peak maxima. d) not determined for the low pressure isotherms ($P/P_o < 0.1$). e) As obtained from the DFT fitting report summary for the full isotherm, provided by the Autosorb iQ 2.02 software.

Table S2: Specific capacitance of laver-based carbons in 1 M TEA-BF$_4$/PC electrolyte at different current densities.

Sample		**10 mA/g [F g^{-1}]**	**50 mA/g [F g^{-1}]**	**100 mA/g [F g^{-1}]**
LC	Positive	1.0	0.7	0.7
	Negative	0.9	0.7	0.7
RLC-700	Positive	1.0	0.9	0.9
	Negative	0.9	0.7	0.7
RLC-1000	Positive	11.4	7.0	5.4
	Negative	5.4	3.5	2.9

Both LC and RLC-700 possess a similar specific capacitance, and the positive electrode exhibits higher capacitance than the negative electrode because of the different ion size between anion and cation. There is a slight increase of capacitance at higher current densities when LC is reduced to RLC-700, resulting from the expansion of the pore entrances with the removal of oxygen/nitrogen groups. The capacitance for the positive electrode is about two times larger than that of the negative electrode when LC is reduced to RLC-1000. In addition, this series of carbon materials will not be suitable as electrode materials in organic electrolytes because most of the micropore surface in these carbons would be inaccessible to organic electrolyte ions.

References

1. A. V. Neimark, Y. Lin, P. I. Ravikovitch and M. Thommes, Carbon 2009, 47, 1617; b) G. Y. Gor, M. Thommes, K. A. Cychosz, A. V. Neimark, *Carbon*, 2012, **50**, 1583.

2. A. Silvestre-Albero, M. Goncalves, T. Itoh, K. Kaneko, M. Endo, M. Thommes, F. Rodríguez-Reinoso and J. Silvestre-Albero, *Carbon*, 2012, **50**, 66.