Supplementary Information

Ideal Porous Structure of EDLC Carbon Electrode with Extremely High Capacitance

K. Urita,[a*] C. Urita,[a] K. Fujita,[a] K. Horio,[b] M. Yoshida[b] and I. Moriguchi[a]

[a] Graduate School of Engineering, Nagasaki University, 1-14 Bunkyo-machi, Nagasaki, Nagasaki 852-8521, Japan.

[b] MicrotracBEL Corp., 8-2-51 Nankohigashi, Suminoe-ku, Osaka 559-0031, Japan.

*Corresponding Author: urita@nagsaki-u.ac.jp

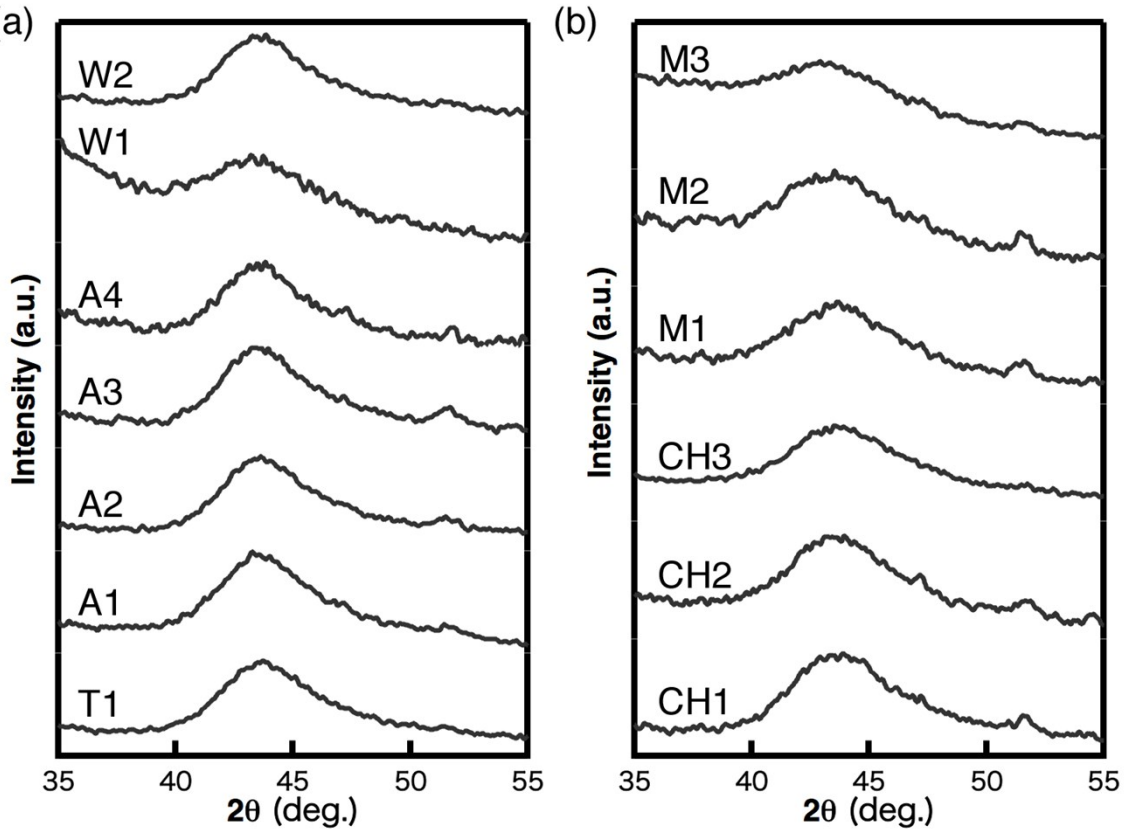

Figure S1. XRD patterns of (a) slit-shape carbon and (b) WL-shape carbon relevant to (10) plane in graphitic structure.

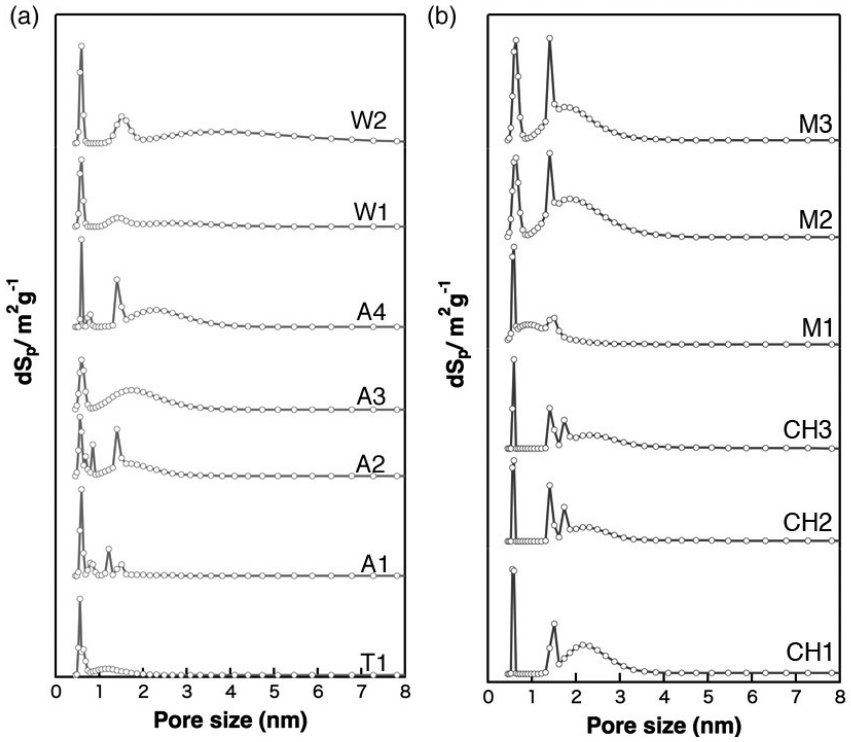

Figure S2. Pore size distribution of (a) slit-shape carbon and (b) WL-shape carbon.

Table S1 Specific surface area of each sample determined from GCMC method. The unit of surface areas is m^2/g.

Sample	Micropore	Mesopore	Macropore	Total
T1	1031	4		1035
A1	1124	11		1135
A2	1271	132		1403
A3	1167	288	0	1455
A4	1168	588		1756
W1	786	116		902
W2	710	342		1052
CH1	796	406		1202
CH2	774	239		1013
CH3	702	297	0	999
M1	2222	57		2279
M2	1353	430		1783
M3	1499	297		1796
PorC18	656	666	15	1337
PorC45	482	411	81	974

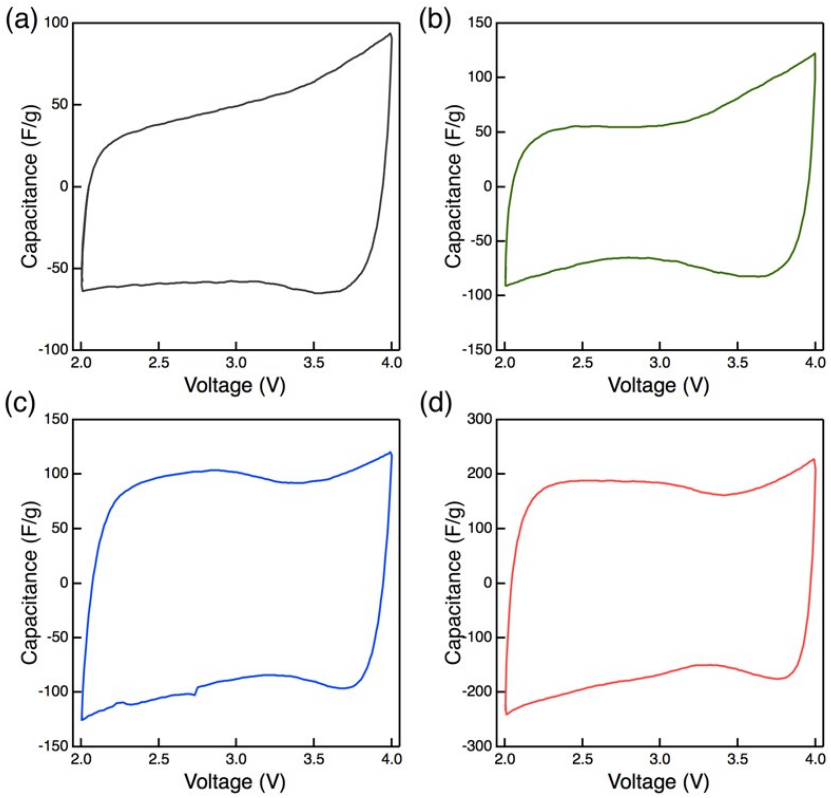

Figure S3. CV curves of representative porous carbon samples, (a) W1 and (b) A4 in the slit-shape and (c) CH2, (d) M3 in the WL-shape.

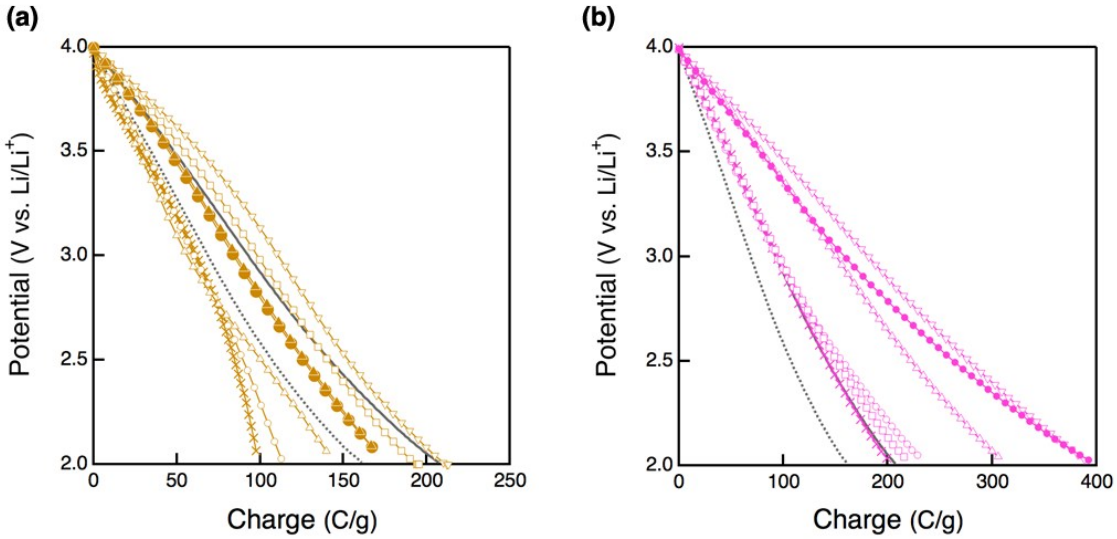

Figure S4. 3rd discharge curves obtained in the CC mode at a current density of 10 mA/g for the slit-shape carbon (Cross, T1; open circle, A1; open square, A2; open triangle, A3; open inverted triangle, A4; closed circle, W1; closed triangle, W2) in (a) and the WL-shape carbon (Cross, CH1; open circle, CH2; open square, CH3; open triangle, M1; open inverted triangle, M2; closed circle, M3) in (b). The grey thin line and dotted line in (a) and (b) are curves of PorC18 and PorC45, respectively.

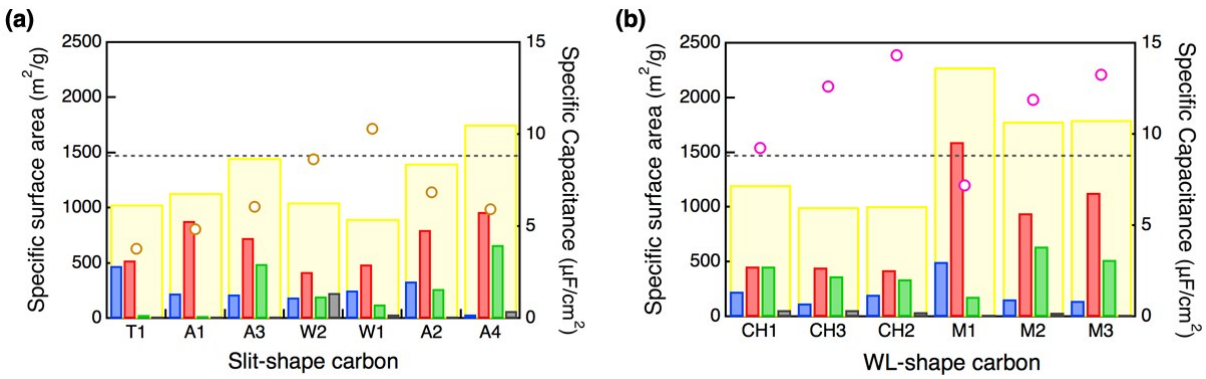

Figure S5. Specific surface area with pore size of < 0.55 nm (blue), 0.55–1.5 nm (red), 1.5–3.0 nm (green), > 3.0 nm (black) and total specific surface area (yellow),and area-specific capacitance at the current density of 10 mA/g (ocher in (a) and pink in (b)) on the slit-shape carbon (a) and WL-shape carbon (b). Grey short-broken lines reveal the area-specific capacitance (8.8 μF/cm²) of PorC18.

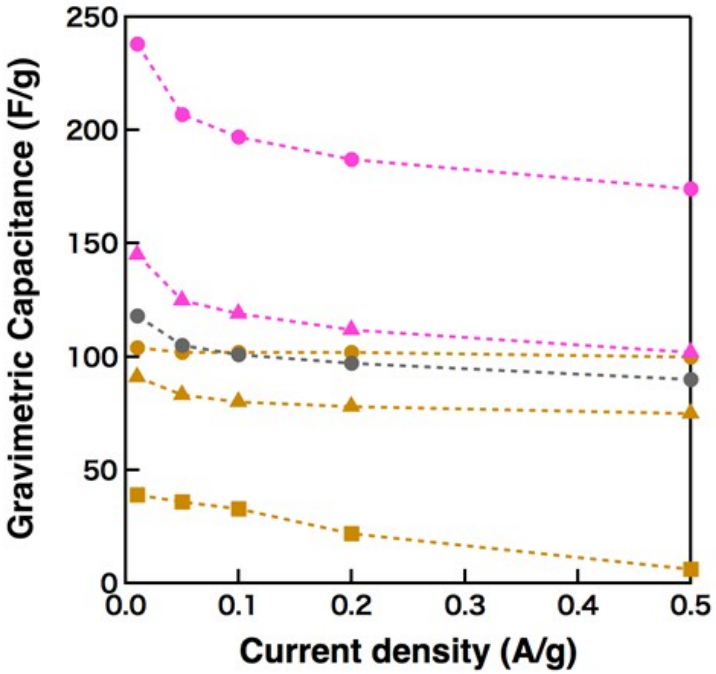

Figure S6. Rate performance of representative porous carbon samples (Pink closed circle, M3; closed triangle, CH2; Grey closed circle, PorC18; Ocher closed circle, A4; closed triangle, W2; closed square, T1).

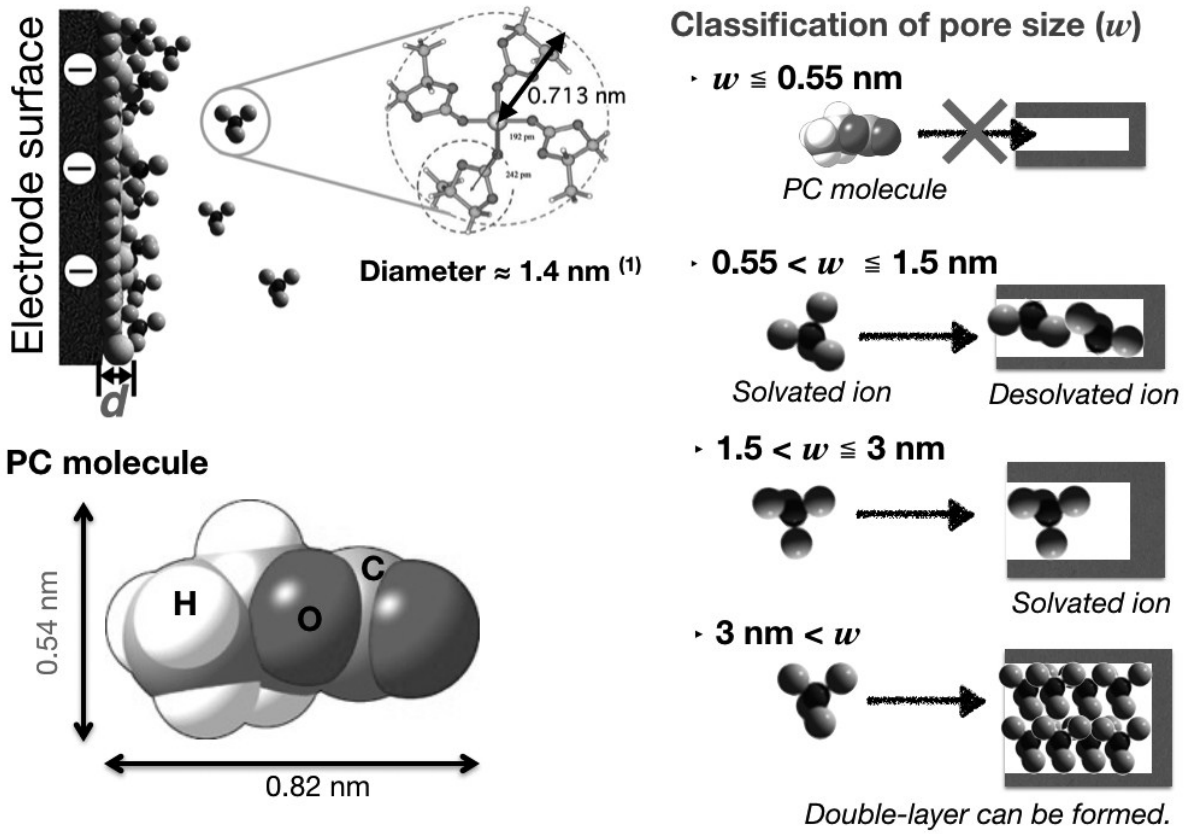

Figure S7 Schematic images relevant to solvated ion size and pore size.

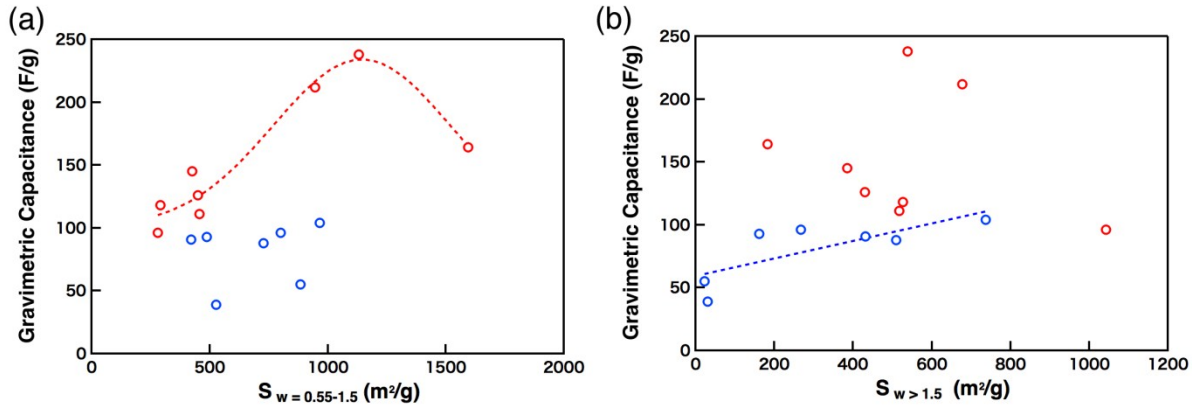

Figure S8. Relationship between the gravimetric capacitance and specific surface area with *w* = 0.55–1.5 nm (a) and > 1.5 nm (b) on slit-shape (blue) and WL-shape (red) carbons.

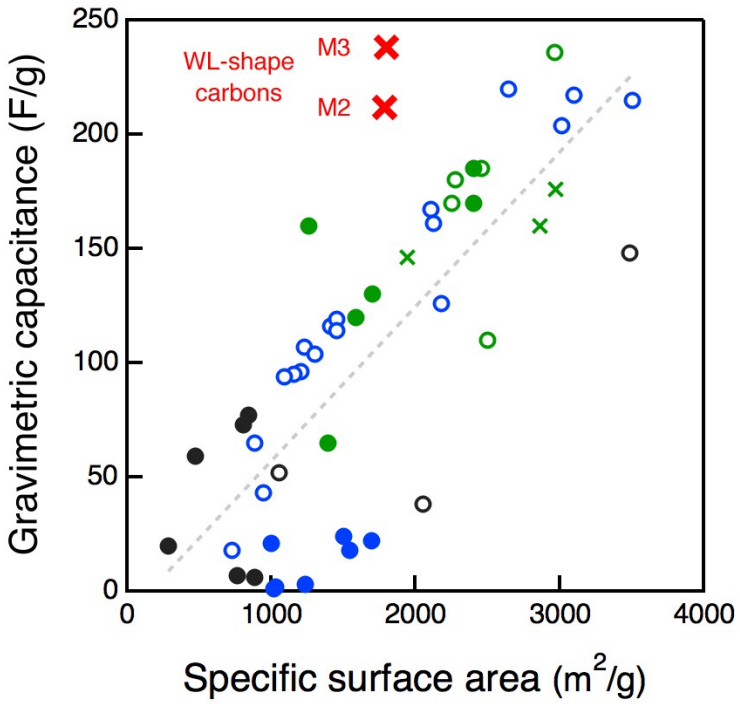

Figure S9. Gravimetric capacitance vs. specific surface are plots of our WL-shape carbons with R_{ssa} = 0.5 (M3) and R_{ssa} = 0.7 (M2) as well as the reported carbons (Blue open circle, activated carbons[2,3]; closed circle, mesoporous carbons[4] in $LiClO_4$/PC; Green open circle, activated carbons[5-7]; closed circle, carbide-derived carbons[8-11]; cross, zeolite-templated carbons[12-15] in $TEABF_4$/AN; Gray open circle, activated carbons[16-18]; closed circle, aerogel-derived carbons[19] in $TEABF_4$/PC).

Supporting references

(1) H. Ohtani, Y. Hirao, A. Ito, K. Tanaka, O. Hatozaki, *J. Therm. Anal. Calorim.* 99(1) (2010) 139.
(2) M. Endo, T. Maeda, T. Takeda, Y. J. Kim, K. Koshiba, H. Hara, M. S. Dresselhaus, *J. Electrochem. Soc.* 148 (2001) A910.
(3) D. L-Castello, D. C-Amoróa, A. L-Solano, S. Shiraishi, H. Kurihara, A. Oya, *Carbon* 41 (2003) 1765.
(4) H. Yamada, I. Moriguchi, T. Kudo, *J. Power Sources* 175 (2008) 651.
(5) P. Azaïs, L. Duclaux, P. Florian, D. Maasiot, M. A. L-Rodenas, A. L-Solano, J-P. Peres, C. Jehoulet, F. Beguin, *J. Power Sources* 171 (2007) 1046.
(6) Y. Korenblit, M. Rose, E. Kockrick, L. Borchardt, A. Kvit, S. Kaskel, G. Yushin, *ACS Nano* 4 (2010) 1337.
(7) L. Wei, M. Sevilla, A. B. Fuertes, R. Mokaya, G. Yushin, *Adv. Energy Mater.* 1 (2011) 356.
(8) J. Chmiola, G. Yushin, Y. Gogotsi, C. Portet, P. Simon, *Science* 313 (2006) 1760.
(9) R. K. Dash, J. Chmiola, G. Yushin, Y. Gogotsi, G. Laudisio, J. Singer, J. FIscher, S. Kucheyev, *Carbon* 44 (2006) 2489.
(10) M. Arulepp, J. Leis, M. Latt, F. Miller, K. Rumma, E. Lust, A. F. Burke, *J. Power Sources* 162 (2006) 1460.
(11) V. Presser, L. F. Zhang, J. J. Niu, J. McDonough, C. Perez, H. Fong, Y. Gogotsi, *Adv. Energy Mater.* 1 (2011) 423.
(12) H. L. Wang, Q. M. Gao, J. Hu, Z. Chen, *Carbon* 47 (2009) 2259.
(13) C. Portet, Z. Yang, Y. Korenblit, Y. Gogotsi, R. Mokaya, G. Yushin, *J. Electrochem. Soc.* 156 (2009) A1.
(14) H. L. Wang, Q. M. Gao, J. Hu, *Microporous Mesoporous Mater.* 131 (2010) 89.
(15) H. Itai, H. Nishihara, T. Kogure, T. Kyotani T, *J. Am. Chem. Soc*. 133 (2011) 1165.
(16) H. Yang, M. Yoshio, K. Isono, R. Kuramoto, *Electrochem. Solid-State Lett.* 5 (2002) A141.
(17) Y. J. Kim, Y. Horie, S. Ozaki, Y. Matsuzawa, H. Suezaki, C. Kim, N. Miyashita, M. Endo, *Carbon* 42 (2004) 1491.
(18) D. H-Jurcakova, M. Kodama, S. Shiraishi, H. Hatori, Z. H. Zhu, G. Q. Lu, *Adv. Funct. Mater.* 19 (2009) 1800.
(19) B. Szubsda, A. Szmaja, A. Halama, *Electrochim. Acta* 86 (2012) 255.