Lignin derived activated carbon particulates as electric supercapacitor:

carbonization and activation on porous and microstructures

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Figure S1. EDX of PAC (30 min, N_2 , 10 °C/min, impregnation ratio of 1) carbonized at 850 °C; inserted table: carbon content (wt%) of PAC at 850, 900 and 950 °C.





Figure S2. Raman spectrum of AL_{ls} PAC (30 min, N₂, 10 °C/min, ratio 1) at (a) 850 °C, (b) 900 °C and (c) 950 °C



Figure S3. Effect of pyrolytic temperature on pore structures of PACS (850 °C, 1 impragnation ratio, 0.5 h, N₂) activated by NaOH (a,c,e.g) and KOH (b,d,f,h): (a,b) nitrogen adsorption-desorption isotherm; (c,d) BJH neck size distribution; (e,f) micropore hydraulic diameter distribution; (g,h) BJH mesopore/cavity width distribution. Inset tables: (e,f) pore volume; (g,h) surface area.



Figure S4. The effect of holding time on pore structures of PACs (850 °C, ratio 1, N₂) activated by NaOH (a,c,e.g) and KOH (b,d,f,h) : (a,b) nitrogen adsorption-desorption isotherm; (c,d) BJH neck size distribution; (e,f) micropore hydraulic diameter distribution; (g,h) BJH mesopore/cavity width distribution. Inset tables: (e,f) pore volume; (g,h) surface area.



Figure S5. The effects of impregnation ratios on pore structures of PACs (900 °C, N₂, 30 min, 10 °C/min): (a,b) nitrogen adsorption-desorption isotherm; (c,d) BJH neck size distribution; (e,f) BJH pore/cavity width distribution; (g,h) micropore hydraulic diameter distribution. Inset tables: (e,f) surface area; (g,h) pore volume.



Figure S6. SEM (a-d) and TEM (e-h) of PACs (900 °C, 30 min, N₂, 10 °C/min) activated by NaOH at 1 (a,e) and 2 (c,g); KOH at 1 (b,f) and 2 (d,h) impregnation ratios.