

Supporting Information

1. Scanning electron microscopy (SEM)

Scanning electron microscopy (SEM) was performed for microstructural investigation. For characterization of the surface structure on the μm -scale, SEM images have been recorded with a FEI Nova NanoSEM 230 at an acceleration voltage of 5 kV. Figure S1 illustrates the resin and the pyrolyzed and activated carbon. The resin exhibits many macropores and looks similar to a cauliflower. During pyrolysis the microstructure shows a slight shrinkage. Between the pyrolyzed and activated carbon hardly any difference can be seen.

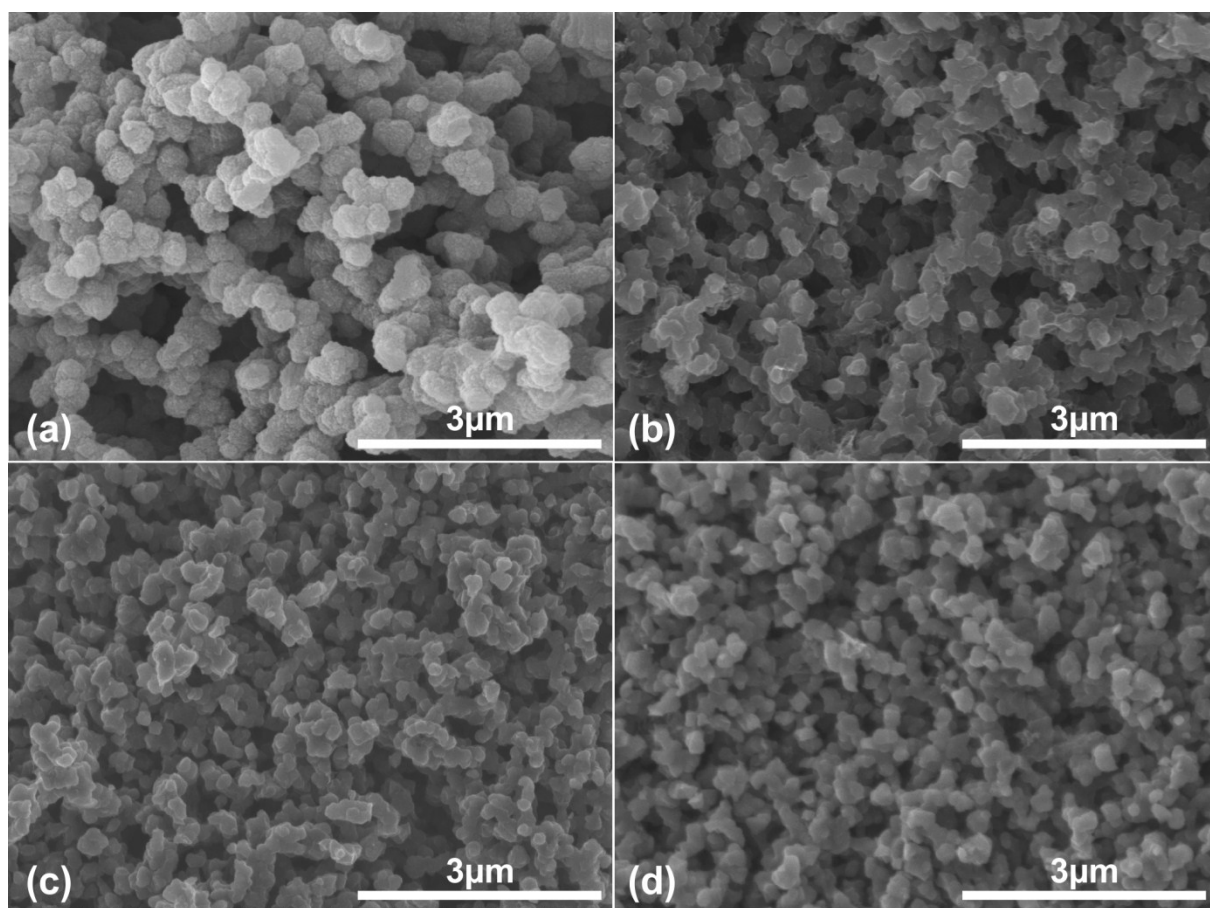


Figure S1. Secondary electron SEM images of (a) A, (b) A-p900, (c) A-p900-1:1-KOH-1h and (d) A-p900-CO₂-3h

2. Raman spectroscopy

Samples were cut with a diamond saw into cylinders with a diameter of 10 mm and a height of 4 mm. After washing in acetone in an ultrasonic bath, the samples were dried in an oven at 50°C overnight. The experimental procedure was following: Raman spectra were measured on a Renishaw 2000 spectrometer equipped with holographic notch filters for elastic scattering and a CCD array detector. The data were accumulated with a WiRE software while the samples were excited with a HeNe laser (632.816 nm). An objective lens (20× magnification) was used to focus the laser onto the sample. The instrument was calibrated with a Si single crystal (Raman band at $\sim 520\text{ cm}^{-1}$). The spectra were recorded at room temperature with an exposure time of 30 seconds and the measurement was repeated five times and accumulated. Figure S2 illustrates the Raman spectra of the RMF-derived carbons pyrolyzed and activated in CO_2 for different times. At ca. 1357 cm^{-1} and 1580 cm^{-1} two wide bands are present. The peak located at 1357 cm^{-1} is due to a disordered structure in the carbon, whereas that close to 1580 cm^{-1} is owing to the graphitic structure. The increase in the intensity of the Raman-active bands for longer activation times might indicate a lower degree of light absorption or reflection for the samples with long activation treatment. However, the ratio of the D- and G-band intensities as well as the full width at half maximum of either band remains approximately constant upon pyrolysis in the investigated temperature and time range. Therefore, it can be concluded that there is no graphitization or pronounced improvement of ordering occurring for these samples, which is in agreement with the XRD results.

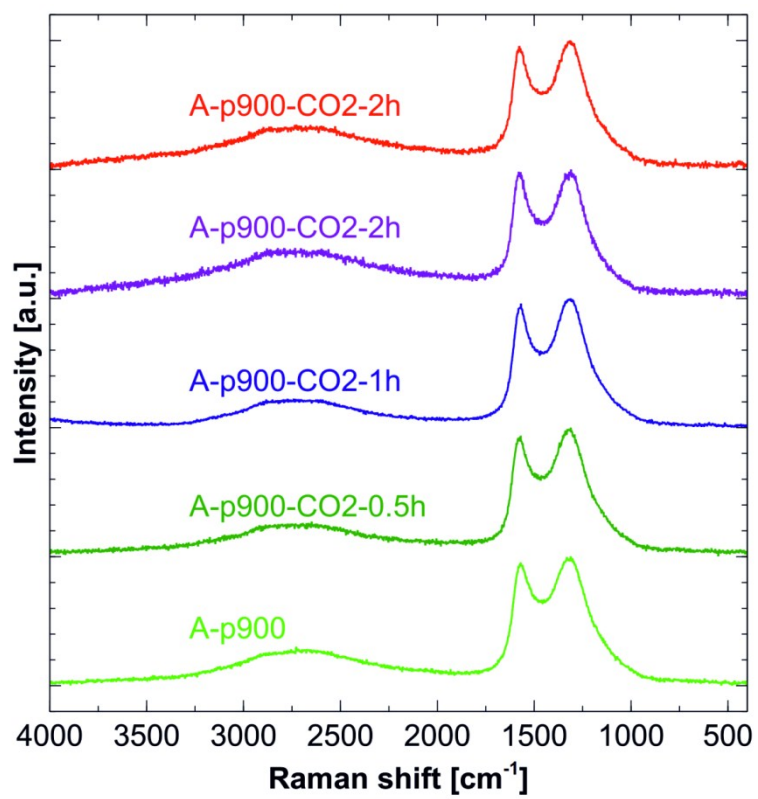


Figure S2. Raman spectra of RMF-derived carbons pyrolyzed and activated in CO₂ for different times

3. XPS

Figure S3 shows the N 1s spectra and Table S1 lists the relative contribution of each moiety. The N 1s spectra can be deconvoluted into four different chemical states, namely pyridinic-type nitrogen (N-6), pyrrolic and/or pyridine-type nitrogen (N-5), quaternary nitrogen (N-Q) and pyridine nitrogen-oxide (N-X) with the relative peak distances fixed according to the values reported by Pels et al.¹. The full width of half maximum (FWHM) was fixed to be ≤ 2.2 eV. The average resulting peak positions were within ± 0.4 eV compared to the average reference values reported in literature^{1,2}. Particularly, after KOH activation the signal to noise ratio is quite low and the observed pyrrolic/pyridone peak might be entirely due to noise. Therefore, we do not expect a better accuracy than $\pm 3\%$.

The physical activation with CO₂ does not seem to influence the relative composition of the four different chemical states. However, chemical activation by KOH seems to decrease the concentration of pyrrolic and/or pyridone groups significantly.

The C 1s spectrum of the KOH activated carbon is shown in Figure S4. No signal of the K2p_{1/2} (293.1 eV) peak and of the K2p_{2/3} (295.94 eV) peak can be observed³. It can be claimed, that almost all potassium salts are removed after washing the sample for one week with distilled water.

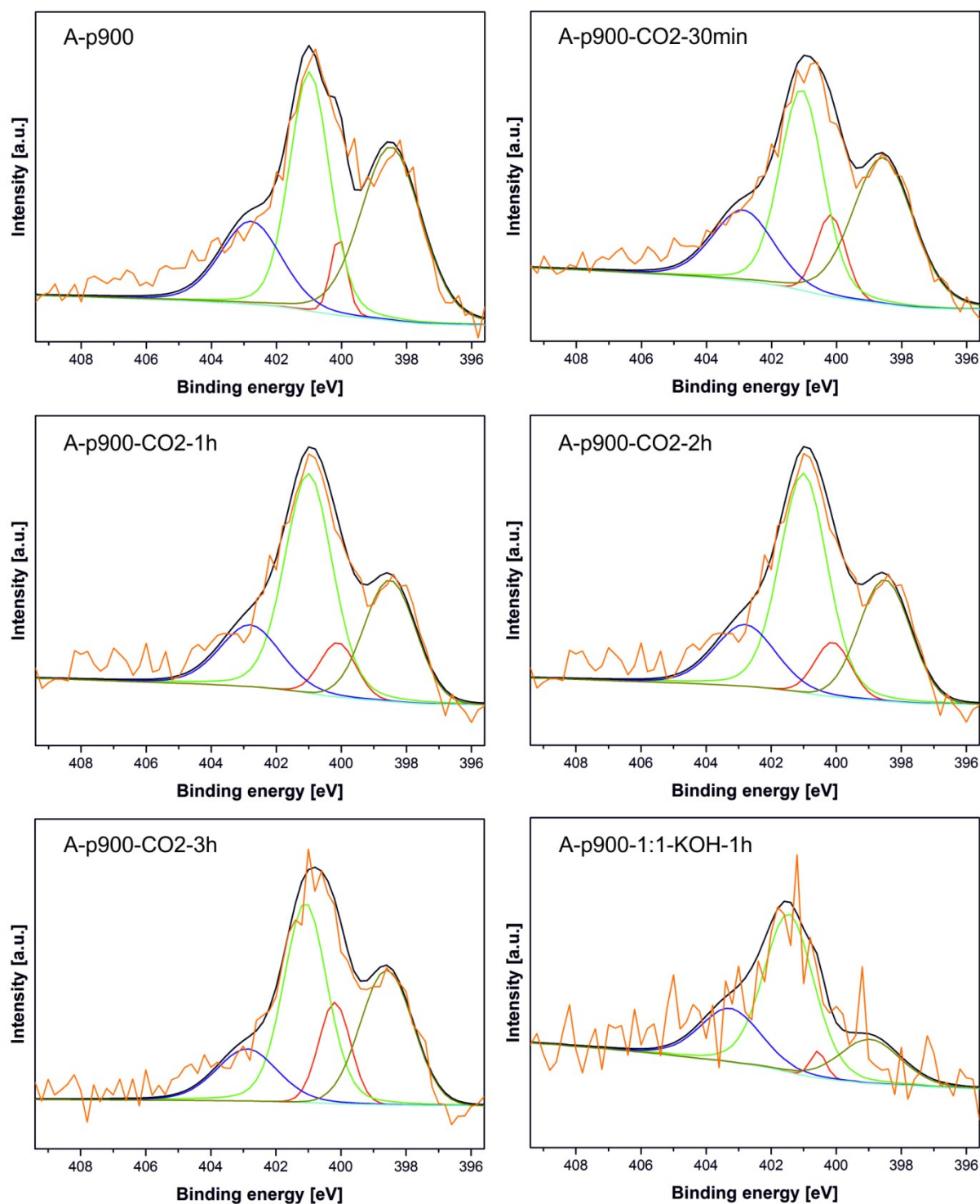


Figure S3. Deconvolution of the N 1s spectra of pyrolyzed as well as physically and chemically activated carbon

Table S1. Binding energies and relative surface concentration of nitrogen species obtained by fitting the N 1s core level XPS spectra

Sample	N-6			N-5			N-Q			N-X		
	B.E. [eV]	FWHM	%	B.E. [eV]	FWHM	%	B.E. [eV]	FWHM	%	B.E. [eV]	FWHM	%
A-p900	398.48	2.2	39.85	400.08	0.59	4.86	400.98	1.45	36.22	402.78	2.2	19.07
A-p900-CO2-30min	398.58	2.2	36.81	400.18	1.06	9.08	401.08	1.57	36.20	402.88	2.2	17.92
A-p900-CO2-1h	398.5	1.87	26.28	400.1	1.3	8.23	401	1.73	48.24	402.8	2.2	17.25
A-p900-CO2-2h	398.61	2.2	36.93	400.21	0.98	9.11	401.11	1.57	38.23	402.91	2.2	15.73
A-p900-CO2-3h	398.59	1.9	30.32	400.19	1.15	13.83	401.25	1.57	40.91	403.05	2.2	14.94
A-p900-1:1-KOH-1h	398.95	2.18	18.60	400.55	0.55	2.90	401.45	1.82	55.63	403.25	2.2	22.87

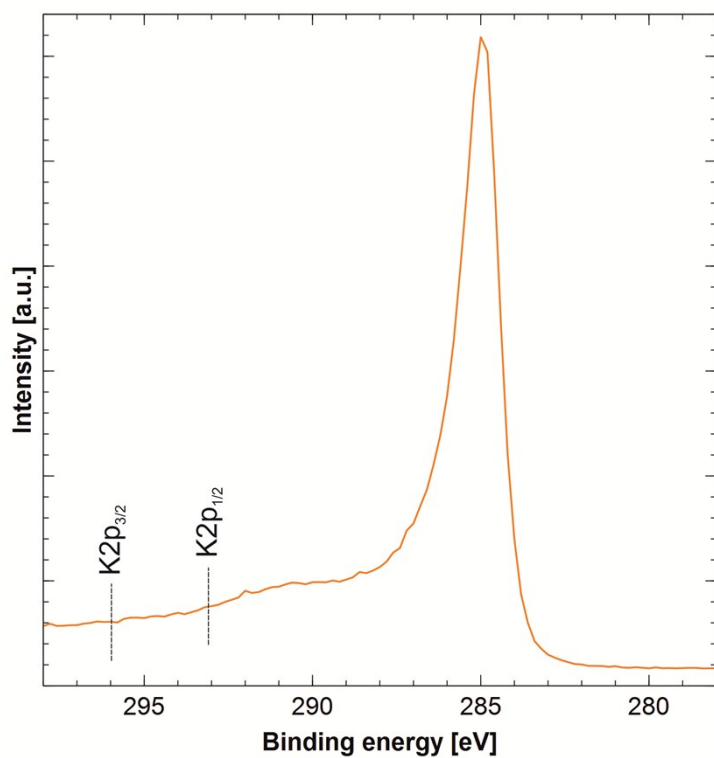


Figure S4. C 1s spectra of the chemically activated carbon (A-p900-1:1-KOH-1h)

References

- 1 J. R. Pels, F. Kapteijn, J. a. Moulijn, Q. Zhu and K. M. Thomas, *Carbon N. Y.*, 1995, **33**, 1641–1653.
- 2 S. R. Kelemen, M. L. Gorbaty and P. J. Kwiatek, *Energy & Fuels*, 1994, **8**, 896–906.
- 3 A. S. Hameed, M. V Reddy, N. Sarkar, B. V. R. Chowdari and J. J. Vittal, *RSC Adv.*, 2015, **5**, 60630–60637.