Supporting Information

Nitrogen- and phosphorus-co-doped carbons with tunable enhanced surface areas promoted by the doping additives

EXPERIMENTAL DETAILS

All chemicals were acquired from Tokyo Chemical Industries, Alfa Aesar, Sigma Aldrich or VWR, respectively, and used without further purification. Nitrogen sorption isotherms were measured on a Quadrasorb instrument by Quantachrome, samples were degassed at 120 °C for 20 h under high vacuum before the measurements. X-ray diffraction patterns were measured using Cu-K_α radiation on a Bruker D8 Avance powder diffractometer. Transmission electron micrographs were obtained at ZELMI (TU Berlin) from a FEI Tecnai G² 20 S-TWIN microscope. Elemental combustion analysis was performed on an Elementar Vario Micro instrument. ICP-OES measurements were performed at Fraunhofer-Institute of Applied Polymer Research on a Perkin-Elmer® Optima 2100 DV device after exposing the samples to microwaves under acidic conditions for decomposition. Elemental Mapping was performed at ZELMI at TU Berlin on a Jeol JXA-8530F electron microprobe. X-ray Photoelectron Spectroscopy (XPS) experiments were performed in type Theta probe (Thermo Fisher) using monochromatized Al K_α radiation at hν = 1486.6 eV at NIMS, Japan. Peak positions were internally referenced to the C1s peak at 284.6 eV. Spectra were devconvolved using XPSPEAK41 software.

Carbon samples were prepared by stirring BMP-dca and the respective phosphonium additive in the desired ratio for 1 h to achieve homogenisation. TPhPBr did not dissolve completely in BMP-dca, so in this case dispersions were used. The as prepared mixtures were heated to 1000 °C in ceramic crucibles in a Nabertherm box type furnace equipped with a gas inlet, under argon flow of 4 L min^{-1} and with a heating rate of 100 K h^{-1}. After cooling down to room temperature the products were pestled for further analysis.

Templated samples were prepared by mixing 2596 mg (12 mmol) of BMP-dca, 1818 mg of TEtPBr (80 mmol) and 2 mL of deionised water. Upon stirring 6 g of a 40 wt% Ludox® silica nanoparticle dispersion were added. The clear brownish liquid was placed in a ceramic crucible and heated to 1000 °C in a Nabertherm box type furnace equipped with a gas inlet, under argon flow of 4 L min^{-1} and with a heating rate of 100 K h^{-1}. After cooling down the sample was treated in 400 mL of an aqueous solution of NH_4HF_2 (c = 4 mol L^{-1}) for 36 h to dissolve the silica template. The product was regained by centrifugation, followed by 5 washing cycles with deionised water and 10 washing cycles with ethanol. After drying in a vacuum drying oven at 95 °C the sample was pestled for further analysis.

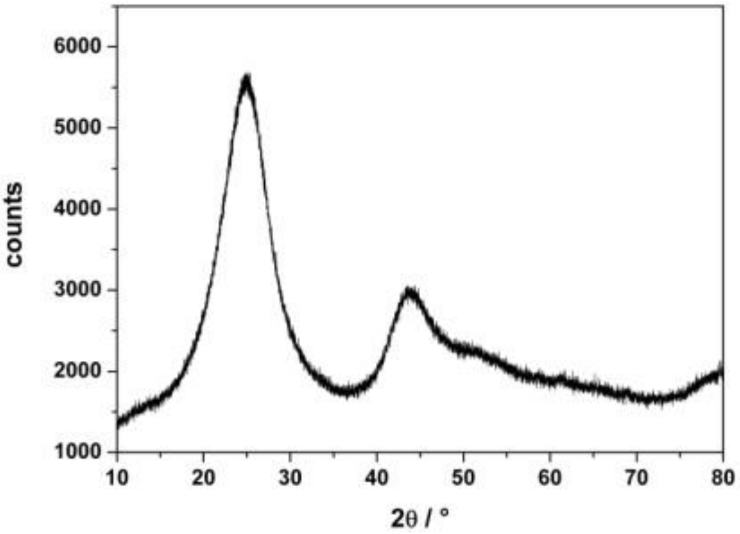

Fig. S 1: PXRD pattern of P/N-doped carbon derived from annealing of BMP-dca/TBuPBr

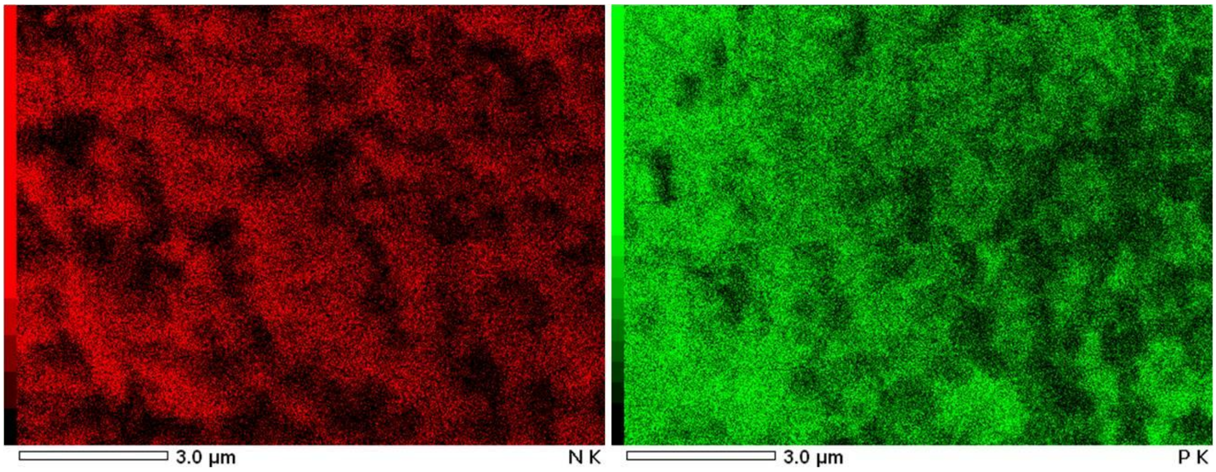

Fig. S 2: EDX-based elemental mapping for nitrogen (left, red) and phosphorus (right, green)

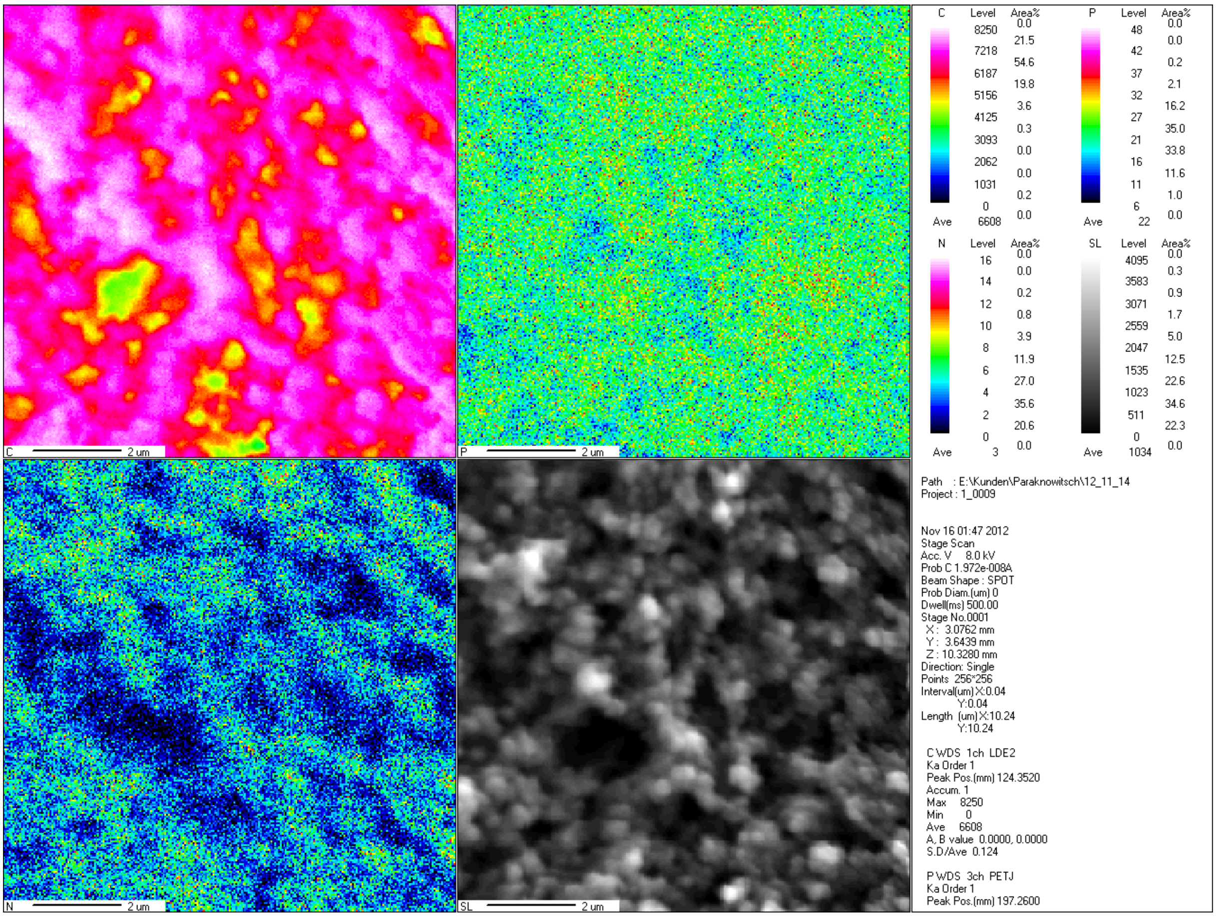

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Fig. S 3: WDX-based elemental mapping for carbon nitrogen and phosphorus, measured at 8 kV

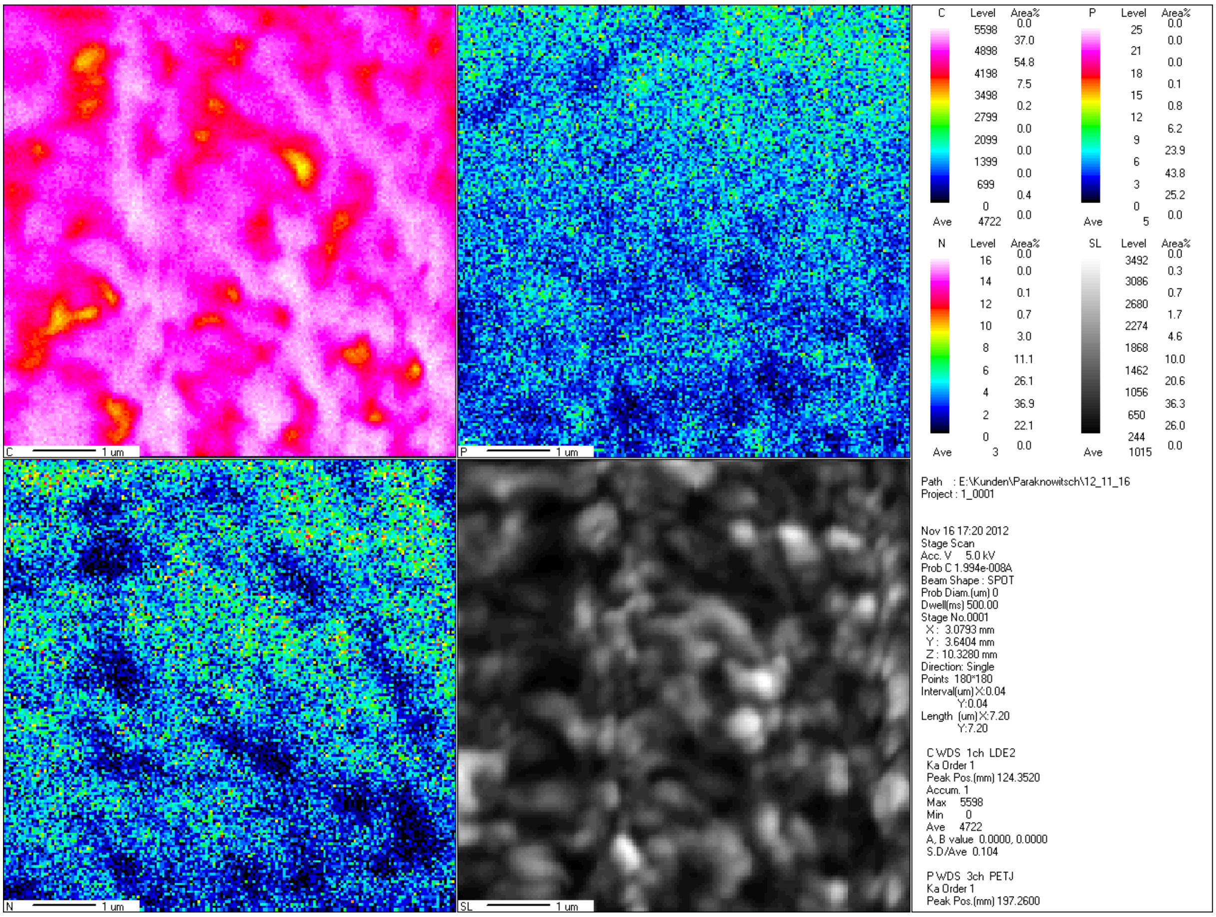

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Fig. S 4: WDX-based elemental mapping for carbon, nitrogen and phosphorus, measured at 5 kV

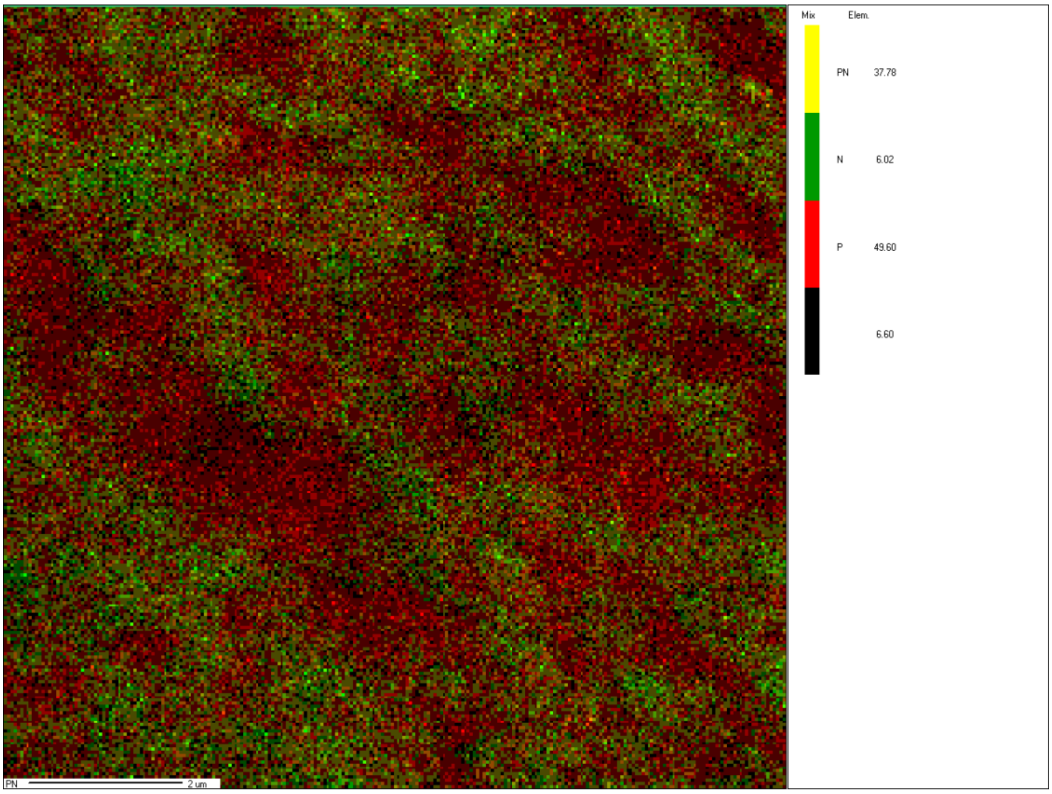

Fig. S 5: Overlayed results of elemental mapping for nitrogen and phosphorus

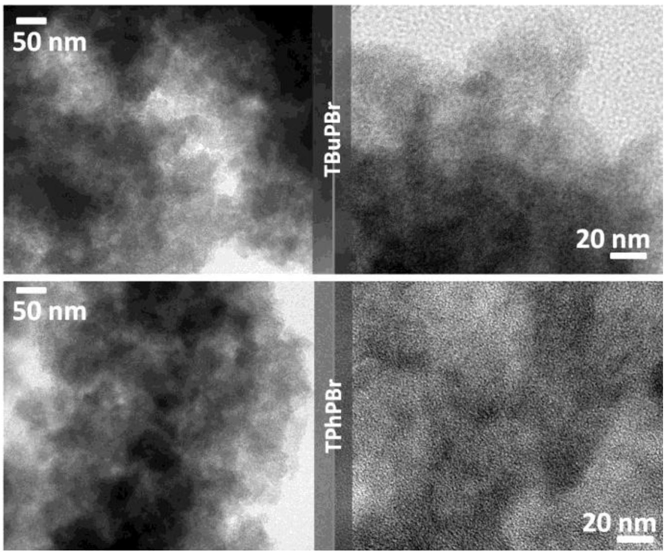

Fig. S 6: Transmission electron micrographs of materials derived from BMP-dca with 40 mol% of phosphonium additives

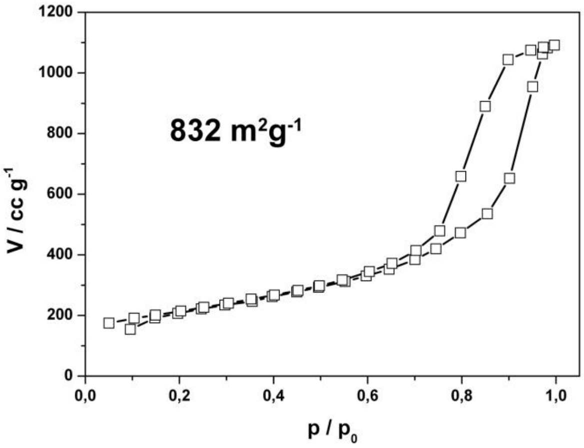

Fig. S 7: Nitrogen sorption isotherm of Ludox® templated material