Electronic Supplementary Material (ESI) for Nanoscale.

Electronic Supplementary Information

Multiscale Anode Materials in Lithium Ion Batteries by Combining Micro- with Nanoparticles: Design of Mesoporous TiO_2 Microfibers@Nitrogen Doped Carbon Composites

Wei Cheng, Felix Rechberger, Darinka Primc, and Markus Niederberger*

Laboratory for Multifunctional Materials, Department of Materials, ETH Zurich, Vladimir-Prelog-Weg 5, 8093 Zurich (Switzerland)

E-mail: markus.niederberger@mat.ethz.ch

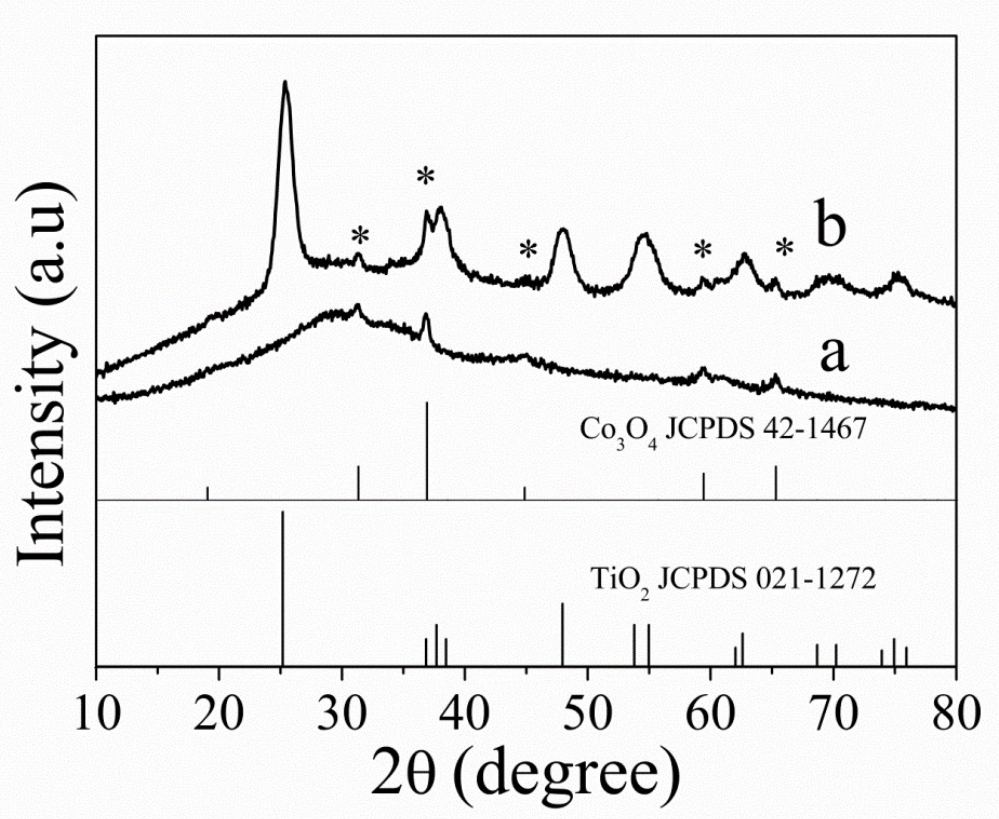

Fig. S1 XRD patterns of the amorphous cobalt silicate nanobelts@TiO_2 a) before and b) after hydrothermal treatment. The reflections marked with the asterisks are from the Co_3O_4 nanoparticles that decorate the amorphous cobalt silicate nanobelts.

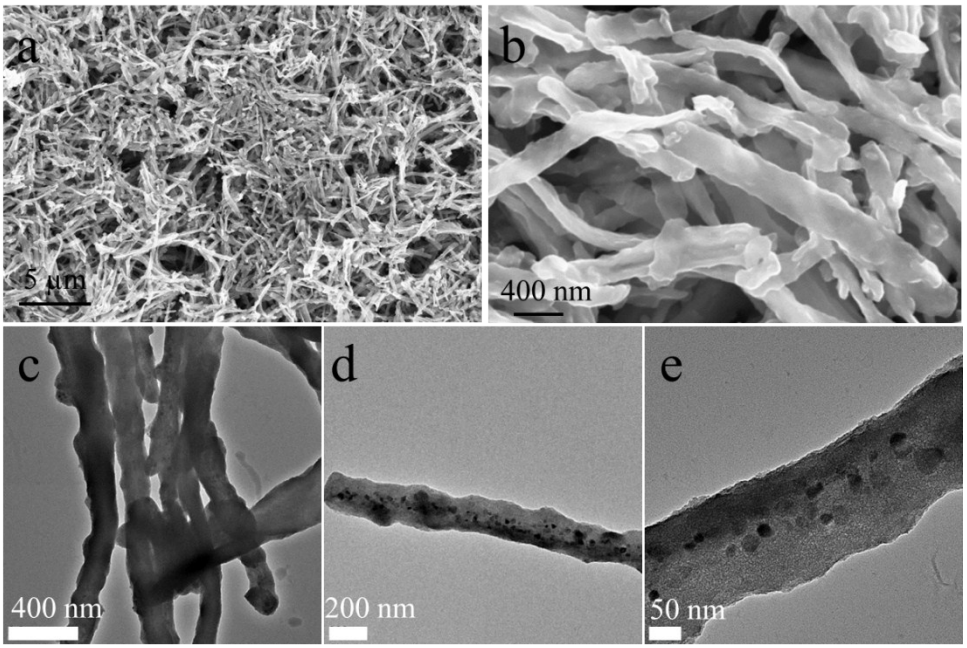

Fig. S2 a-b) SEM and c-e) TEM images of the cobalt silicate nanobelts@amorphous TiO_2.

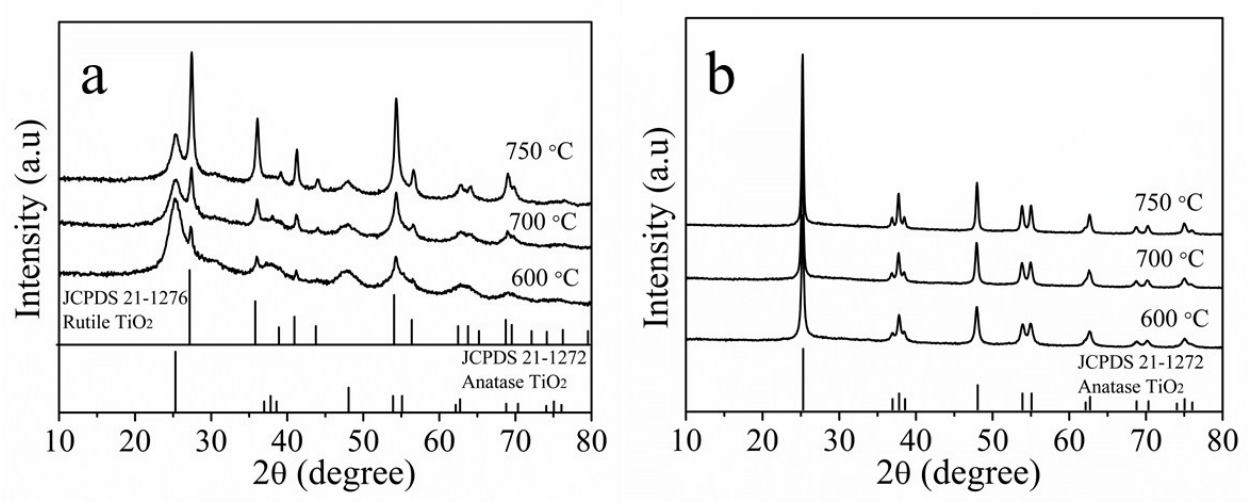

Fig. S3 a) XRD patterns of the samples prepared without a hydrothermal treatment step and b) XRD patterns of the samples prepared without hydrothermal treatment and without polydopamine deposition. All other processes are kept the same. The patterns in a) indicates the presence of a mixture of anatase and rutile TiO_2 nanoparticles. The sharper reflections of the rutile phase point to a larger crystal size compared to the anatase nanoparticles. The samples in b) are phase pure anatase TiO_2.

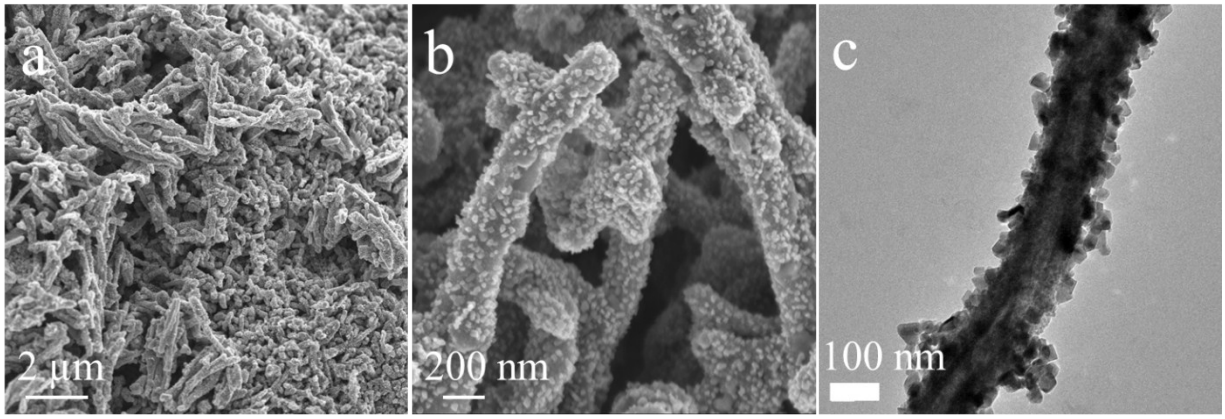

Fig. S4 a-b) SEM images and c) TEM image of the sample prepared without a hydrothermal treatment step, while all other processes are the same (the annealing temperature is 750 °C). Based on the XRD analysis in Fig. S3a, the larger nanoparticles on the surface of the fibers presumably correspond to rutile TiO_2. The smaller anatase nanoparticles build up the skeleton of the fibers.

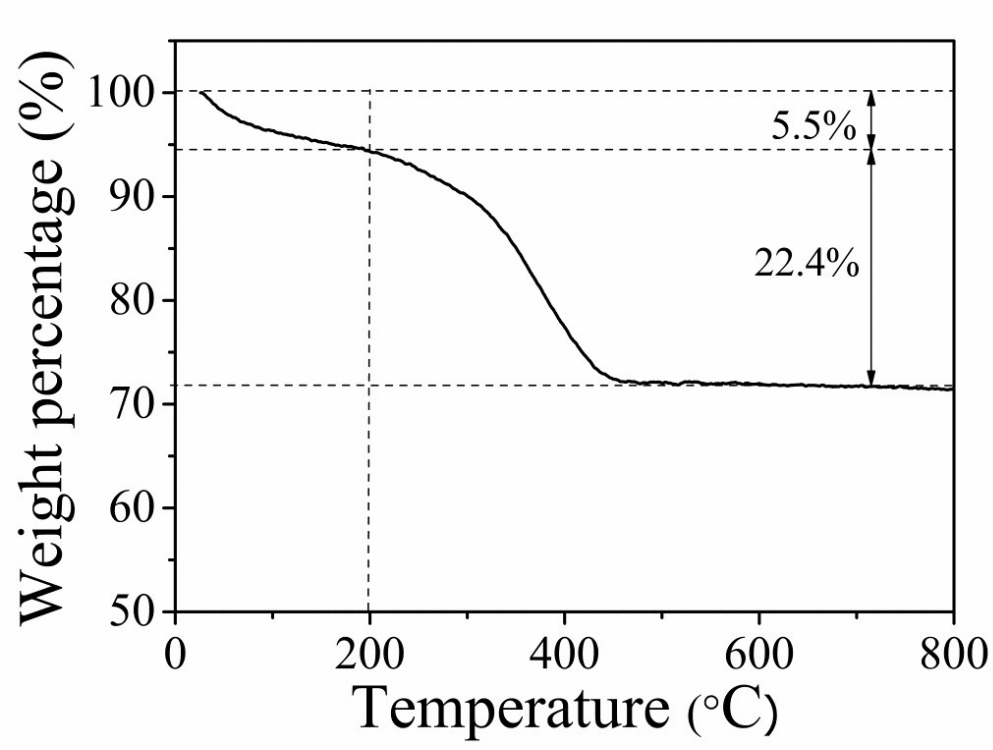

Fig. S5 TGA of the mesoporous TiO_2 fibers@N doped carbon composite synthesized at 750 °C.

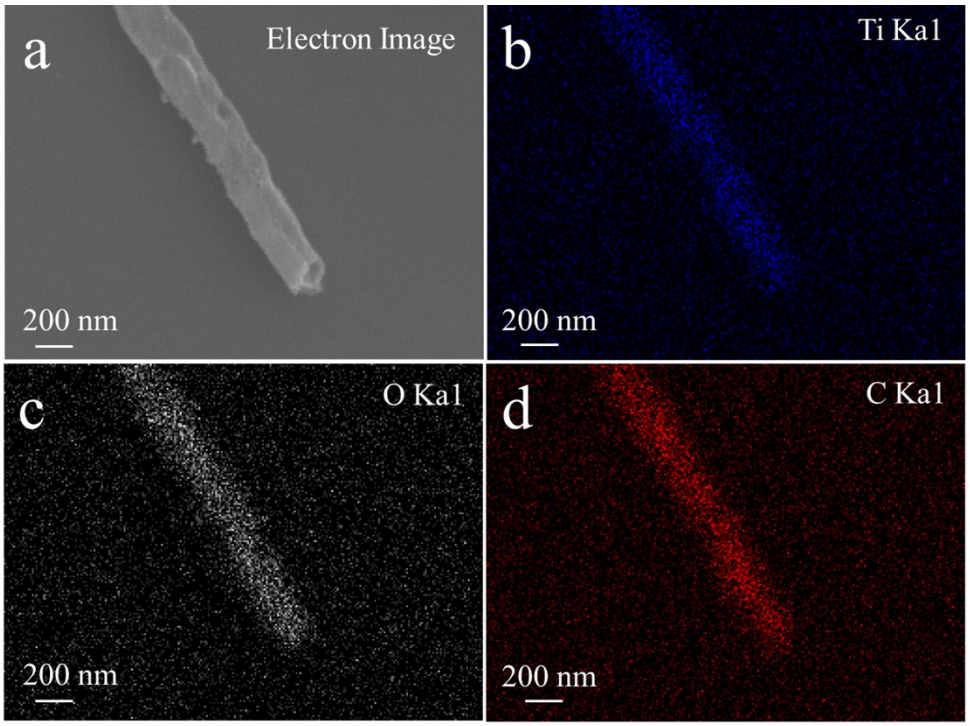

Fig. S6 a-d) EDX element mapping of a single mesoporous TiO_2 fiber@N doped carbon.

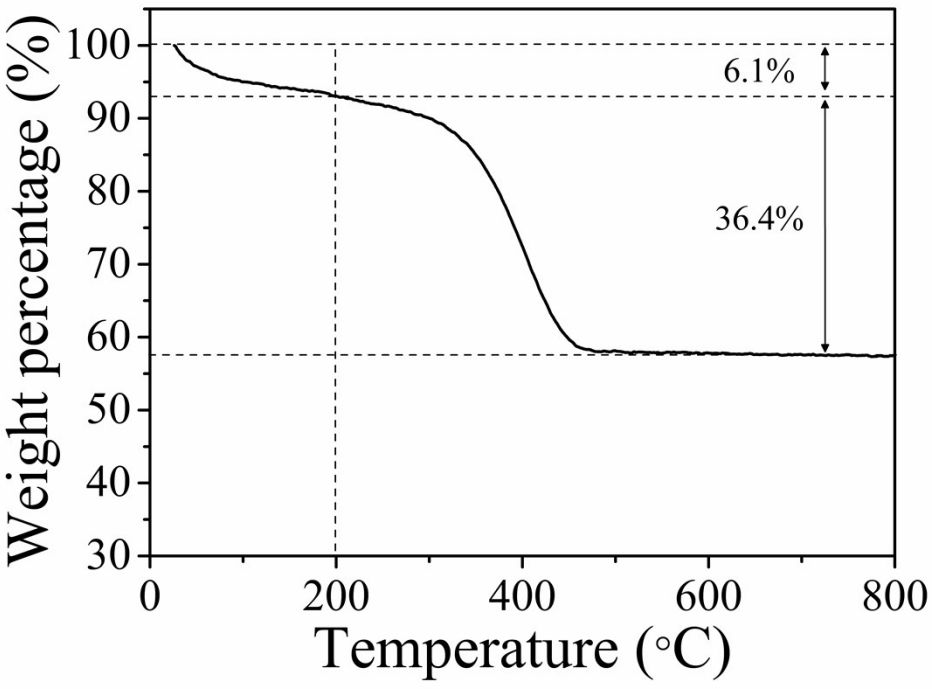

Fig. S7 TGA of the mesoporous TiO_2 fibers@N doped carbon composite synthesized with two dopamine polymerization steps while all other synthetic procedures remain the same.

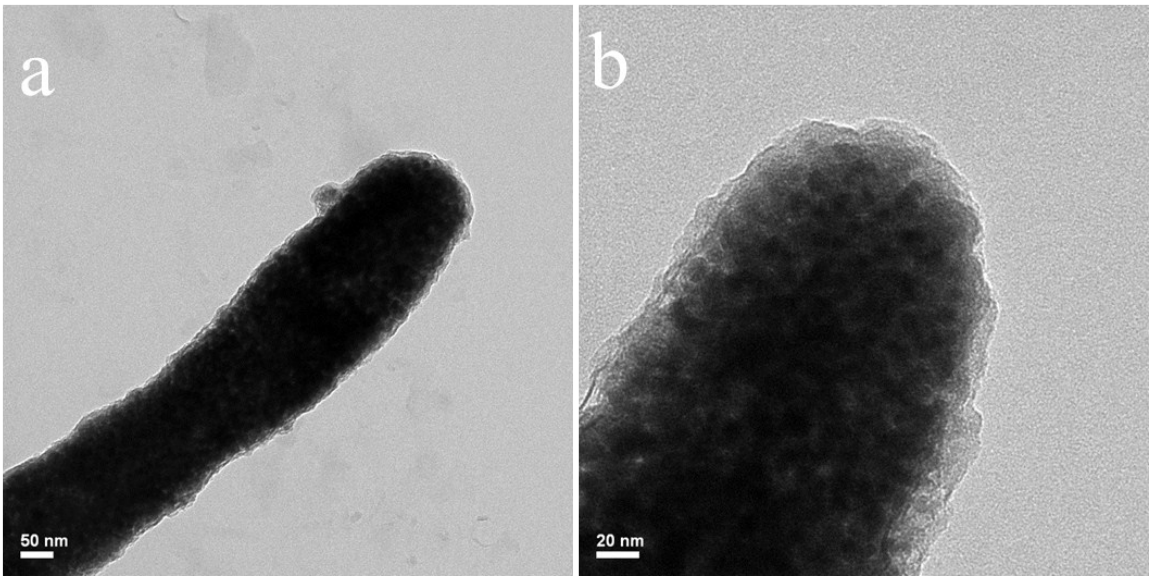

Fig. S8 a-b) TEM images of a mesoporous TiO_2 fibers@N doped carbon composite particle synthesized with two dopamine polymerization steps, while all other procedures remain the same.

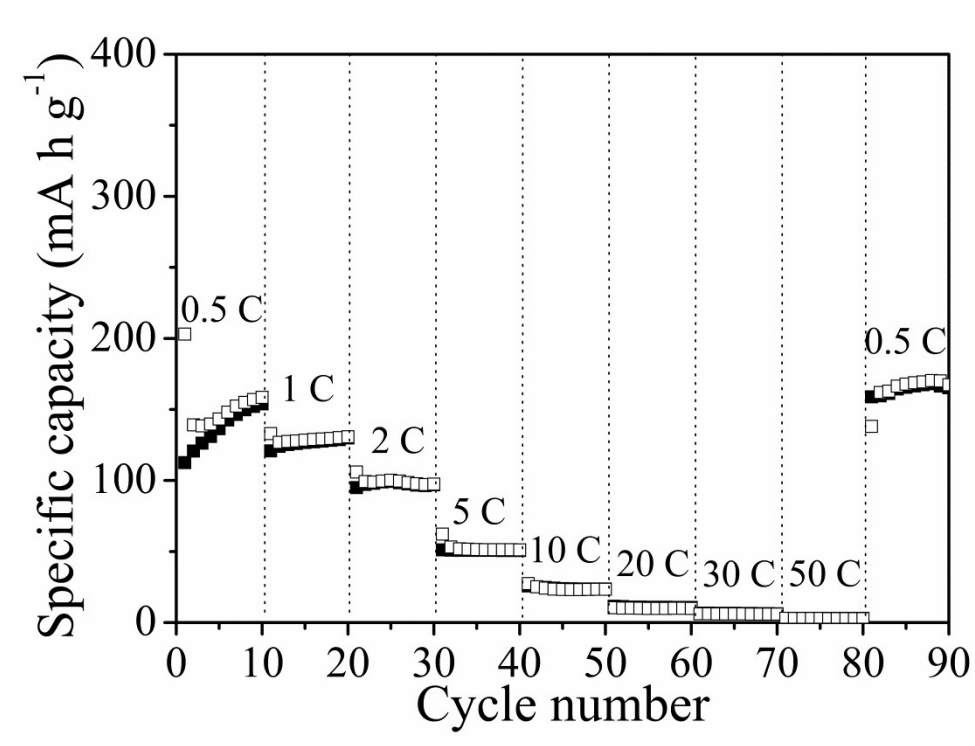

Fig. S9 Rate performance of the mesoporous TiO_2 fibers@N doped carbon composite after two dopamine polymerization steps.

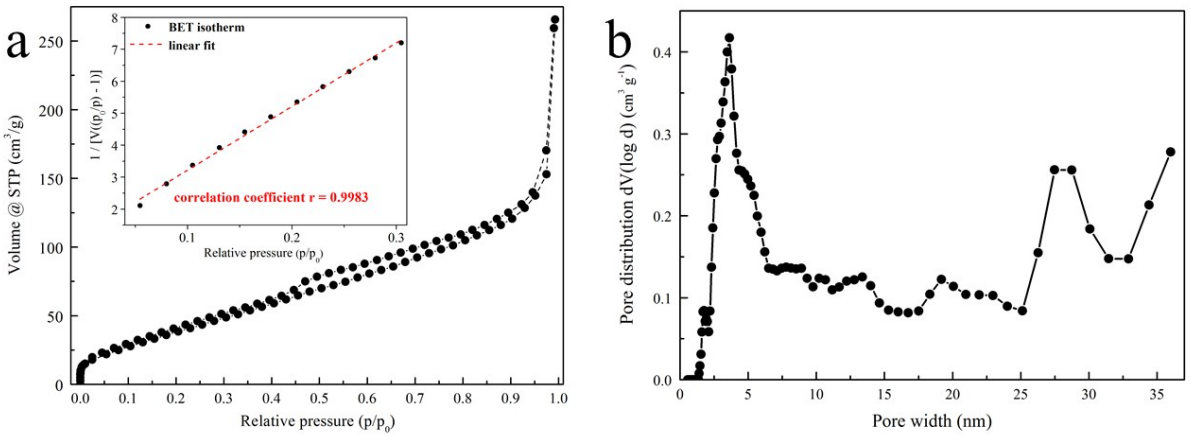

Fig. S10 a) Adsorption-desorption isotherms of mesoporous TiO_2 fibers@N doped carbon composite prepared with two dopamine polymerization steps. The BET surface area is determined to be 164.7 m²/g. b) Pore size distribution obtained by DFT analysis.

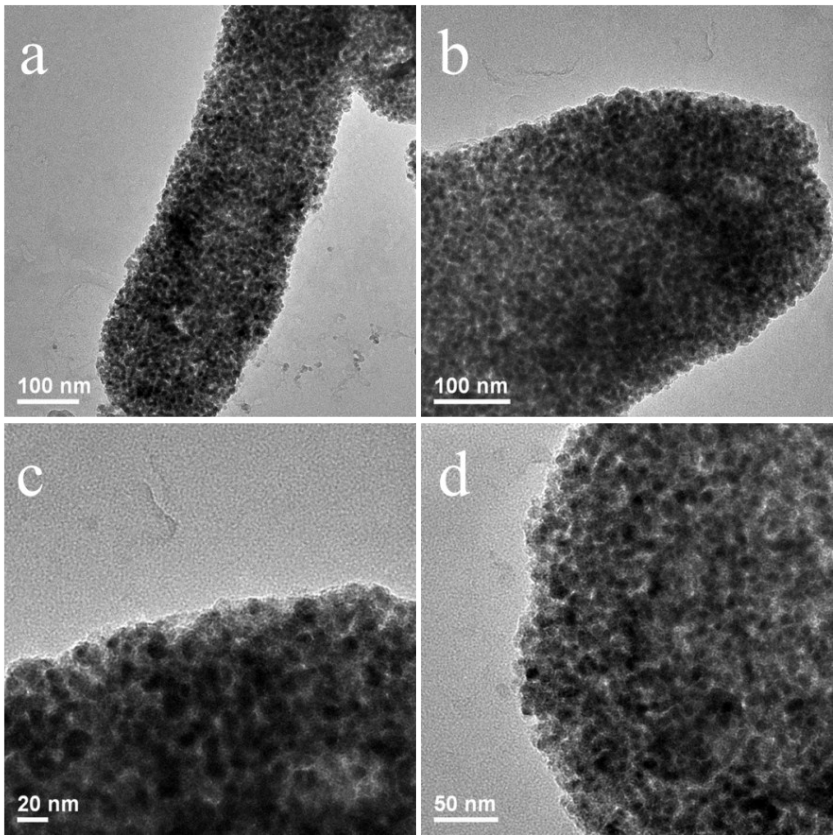

Fig. S11 a-d) TEM images of the mesoporous TiO_2 fibers@N doped carbon composite after 500 cycles at 10 C.