A Nitrogen-Doped Carbon Coated Silicon Carbide as a Robust and Highly Efficient Metal-Free Catalyst for Sour Gases Desulfurization in the Presence of Aromatics as Contaminants

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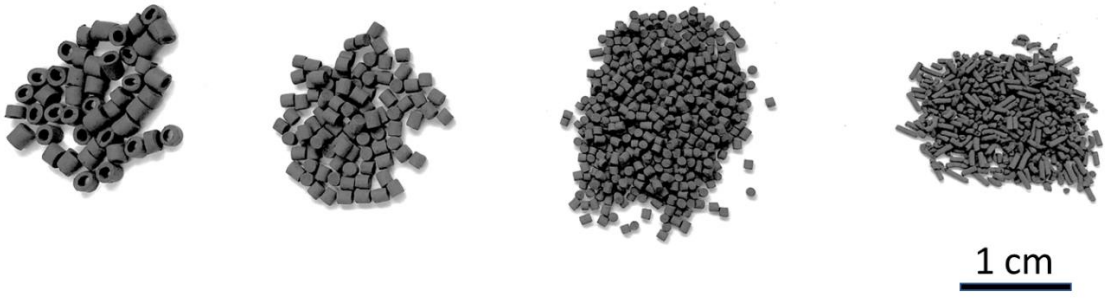

Fig. S1† Digital photos of the β-SiC produced through a gas-solid process with different size and shape: ring, pellets with different diameters (www.sicatcatalyst.com).

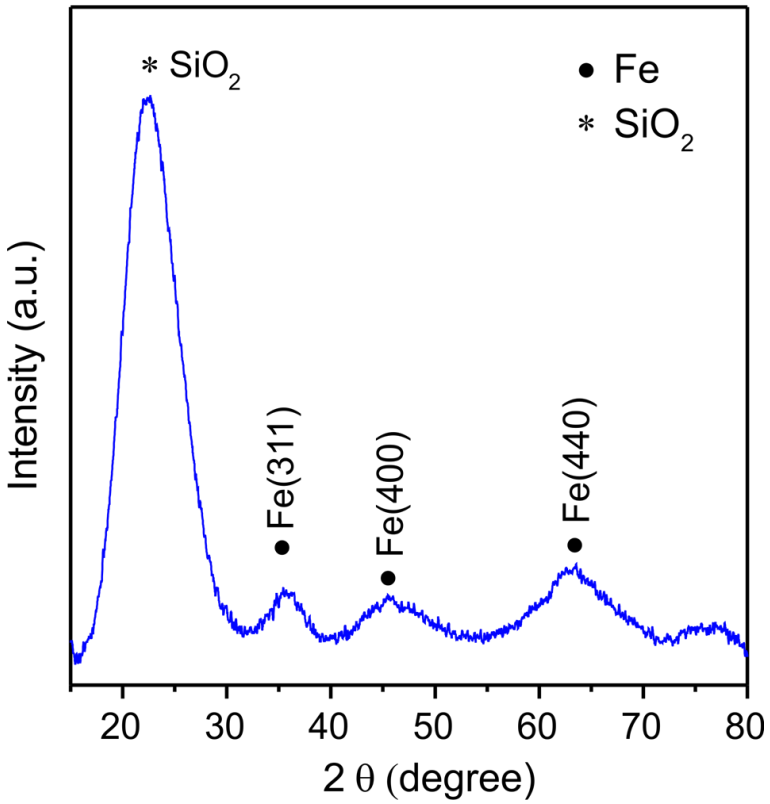

Fig. S2† XRD patterns of Fe_2O_3/SiO_2 catalyst (Fe 2.6 wt.%).

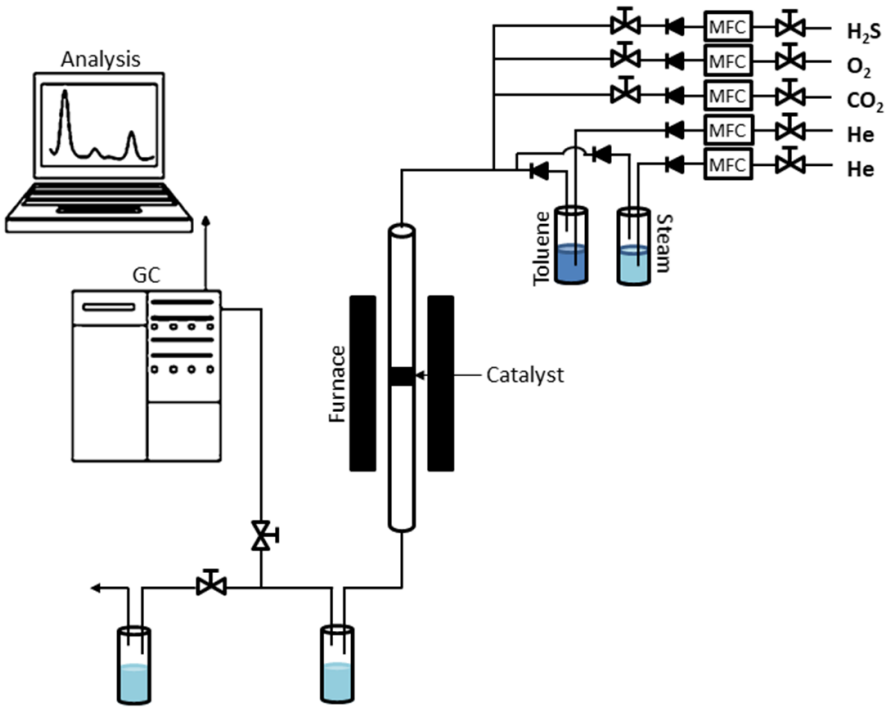

Fig. S3† Schematic illustration of a desulfurization apparatus for testing N-C/SiC as catalyst with or without toluene as contaminant.

Table S1† Selected physico-chemical properties of N-C/SiC and Fe_2O_3/SiO_2 composites along with their pristine supports.

Entry	Sample	N-C wt.% (from TGA)	N wt.% (from EA)[a]	SSA ($m^2 g^{-1}$)	Nitrogen species (%)[b]			
					Pyridinic	Pyrrolic	Graphitic	Oxidized
1	SiC	-	-	25	-	-	-	-
2	N-C/SiC	7.4	1.7	57	53.1	13.1	26.8	7.0
3	SiO_2	-	-	165	-	-	-	-
4	Fe_2O_3/SiO_2	-	-	160	-	-	-	-

[a] Elemental analysis: average values calculated over three independent runs over each sample. [b] Estimated from high resolution XPS N1s core region recorded on N-C/SiC and its relative peak deconvolution.

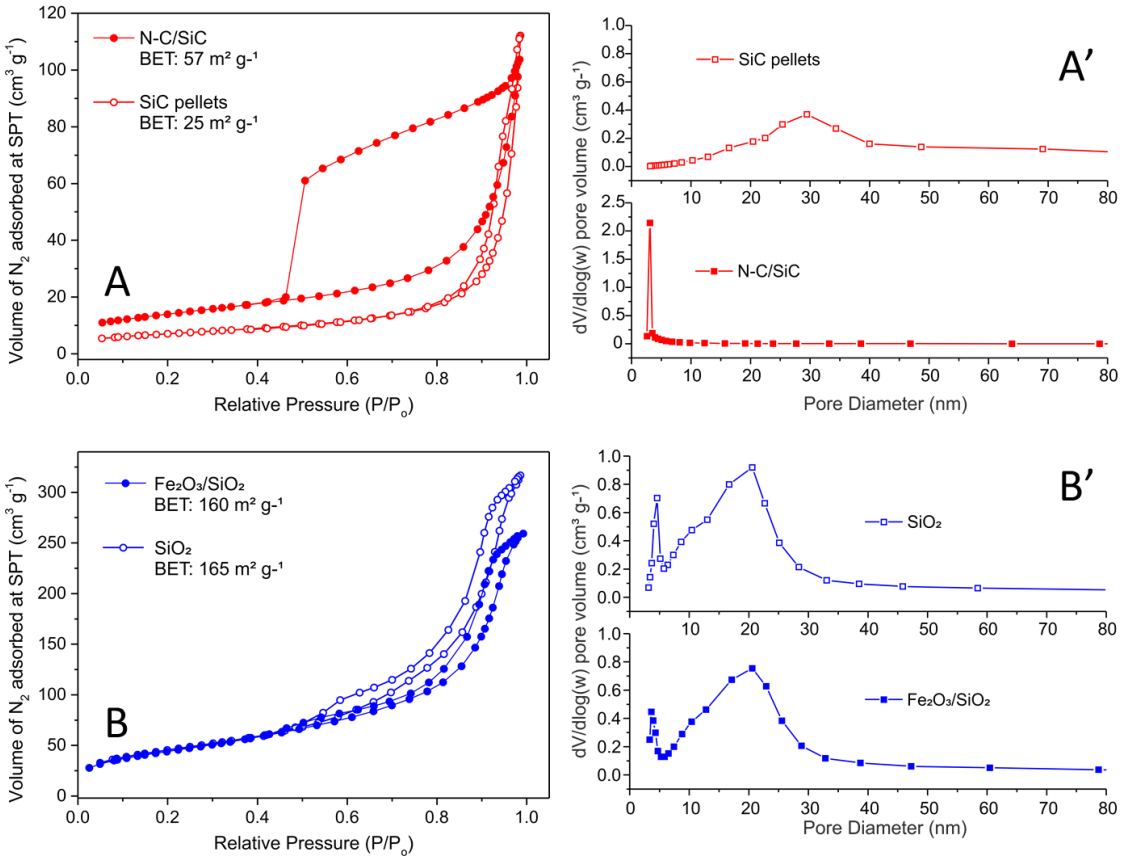

Fig. S4† (**A**) N_2 adsorption-desorption isotherm linear plot (BET) of SiC and N-C/SiC samples (red curves, empty vs. full dots) recorded at 77 K. (**A'**) Pore-size distribution measured (BJH method) for SiC and N-C/SiC samples (red curves, empty *vs*. full squares). (**B**) N_2 adsorption-desorption isotherm linear plot (BET) of SiO_2 and Fe_2O_3/SiO_2 samples (blue curves, empty vs. full dots) recorded at 77 K. (**B'**) Pore-size distribution measured (BJH method) for SiO_2 and Fe_2O_3/SiO_2 samples (blue curves, empty *vs*. full squares).

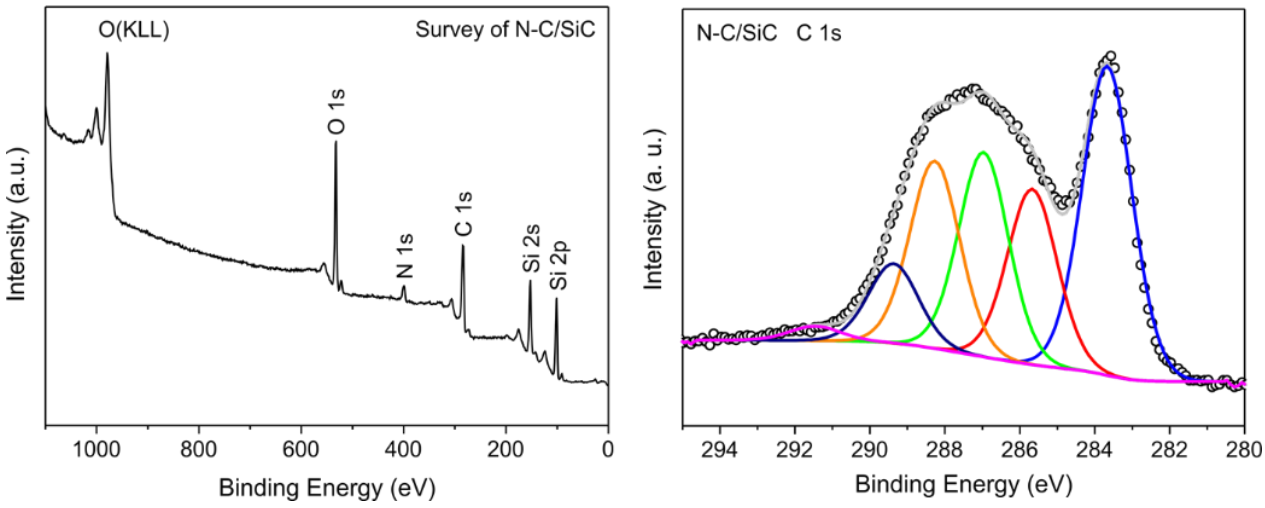

Figure S5† (left) XPS survey spectrum of N-C/SiC. (right) XPS C 1s core region of N-C/SiC along with the relative curve fitting.

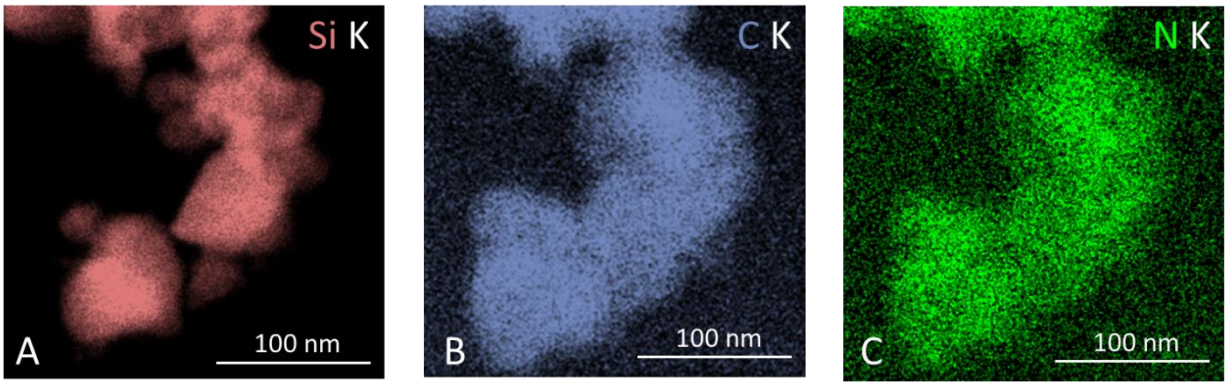

Figure S6† (**A-C**) Compositional elemental mapping of N-C/SiC by STEM-EELS analysis with mapping of Si-K, C-K and N-K ionization edges. N-K indicates a homogeneously distribution of the heteroelement at the outer catalyst surface.

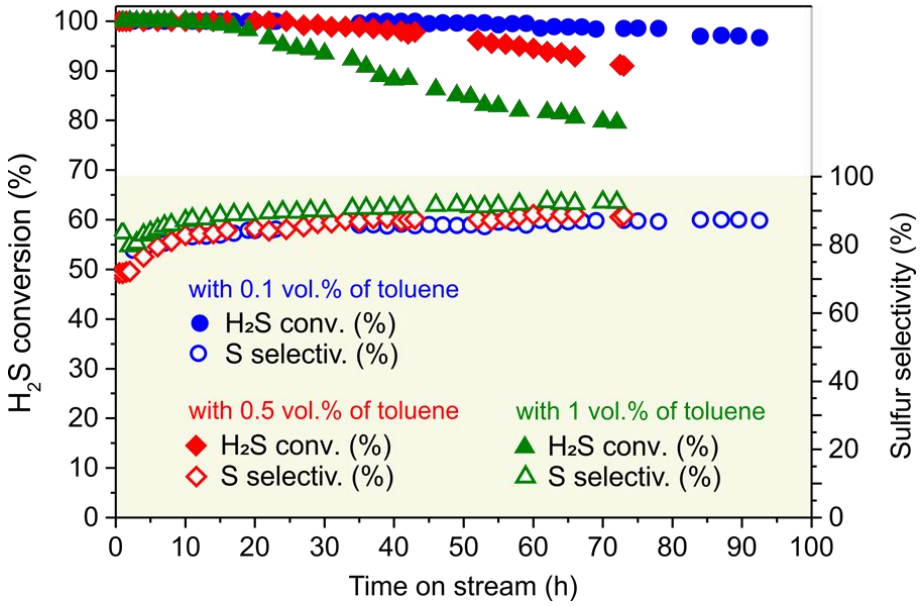

Figure S7† Desulfurization performance on N-C/SiC catalyst in the presence of variable toluene concentrations in the reactants stream {[tol] = 1000 ppm (0.1 vol.%), blue symbols; [tol] = 5000 ppm (0.5 vol.%), red symbols; [tol] = 10000 ppm (1 vol.%), green symbols}. Reaction details common to all runs: N-C/SiC = 6 g (V_{cat} ~ 7.5 cm^3); [H_2S] = 1 vol.%; O_2-to-H_2S ratio = 2.5, [H_2O] = 30 vol.%, He (balance); reaction temperature = 210 °C, GHSV (STP) = 2400 h^{-1}.

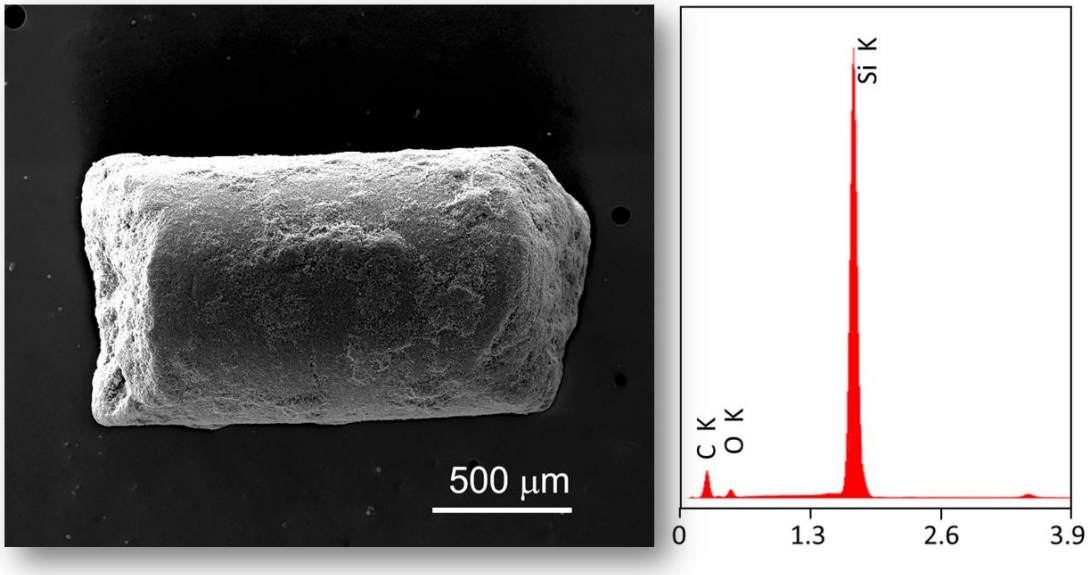

Figure S8† SEM image of freshly prepared N-C/SiC catalysts along with its EDS - X-ray microanalysis.