Supplementary Material (ESI) for Journal of Materials Chemistry

Supplementary Information Available

Support. The SiC foam synthesized according to the gas-solid reaction [13,14,18] with an average pore size of 1900 μm was impregnated with an aqueous solution of $Ni(NO_3)_2$. The nickel loading was set to be 1 wt. %. The solid was oven-dried at 100 °C for 2 h and calcined in air at 350 °C. The reduction was carried out *in-situ* in flowing hydrogen at 400 °C for 2 h. The hydrogen was replaced by a mixture of C_2H_6/H_2 (60/40 ml/ml per minute) and the reaction temperature was increased to 680 °C (heating rate of 20 °C. min^{-1}) [8]. After the synthesis during 4 h the reactor was cooled down to room temperature under the reactants mixture. The reactor was flushed with helium for 30 min before discharging the solid from the reactor.

SiC nanofibers were synthesized by reaction between the CNFs with the SiO vapours under argon atmosphere at 1200°C for 4 h in an electrical oven. The transformation to SiC was accompanied by a consecutive release of CO which was actively flushed out from the reaction zone by the argon flow and thus, shifting the reaction equilibrium towards the formation of SiC [13]. The relatively low synthesis temperature allows the conservation of the specific surface area of the produced SiC material (β-SiC) unlikely the high temperature synthesis where only very low specific surface area, i.e. 0.1 to 1 m_2/g, α-SiC is obtained. After synthesis the ceramic composite was calcined in air at 600°C for 2 h in order to remove the residual carbon in its matrix.

Characterizations. The morphology of the sample was investigated by means of a scanning electron microscopy (SEM) while the microstructure was observed by transmission electron microscopy (TEM). SEM was carried out on a Jeol JSM-6700F working at 3 kV accelerated voltage, equipped with a CCD camera. TEM was carried out on a Topcon 002BUHR microscope working under 200 kV accelerated voltage with a point-to-point resolution of 0.17 nm. The samples were dispersed in ethanol in ultrasonic bath and then a drop was deposited on a holey carbon coated copper grid for examination. Pressure drop measurements were performed on a setup equipped with a Testo 435-1 gas velocity anemometer. The pressure drop was measured with a differential pressure sensor (Keller Druckmesstechnik PD-41, 0-200 mbar) and the gas used was compressed air. Surface area measurements were

carried out on a Micromeritics sorptometer (SA-2100) worked at liquid nitrogen temperature with N_2 as adsorbant. Before measurement the sample was out gassed at 250°C in dynamic vacuum for 2 h in order to desorb any moisture. The oxidative resistance of the materials was investigated by a Temperature-Programmed Oxidation (TPO). The sample was packed in avertical quartz reactor and flushed with helium at room temperature for 30 minutes. The helium flow was replaced by a mixture of O_2 (20 vol.%) diluted in helium with a total flow rate of 50 ml. min-1 and the reactor temperature was increased from room temperature to 700°C with a heating rate of 15°C. min-1. CO_2 was continuously monitored by a mass spectrometer. The ^{29}Si MAS NMR analysis was carried out on a Bruker DSX-400 spectrometer operating at 79.460 MHz. Experiments were performed on a standard double bearing 7 mm broad probe with a spinning frequency of 4 kHz. The average number of scans was about 1000 for all samples. The XPS measurements were performed on a Multilab 2000 (Termo) spectrometer equipped with Al Kα anode (hv = 1486.6 eV).

Diesel Particulates Filtration (DPs). The DPs containing aerosol was produced from a diesel car engine (Peugeot 206 HDI) at a speed of 60 km.h^{-1} at 2,500 rpm. The DPs size and weight were detected by an ELPI (Electrical) purchassed from Dekati Ltd. These experiments are particularly fitted for the calculation of filtration efficiency. ELPI is capable of particulate classification in the range of 10 – 1000 nm. First particles are charged by the corona and then separated by the impactor according to their size. A distribution of the number of particles as a function of their size or their weight can be obtained (Figure 9). Besides this the back pressure was measured with a differential pressure sensor (Keller Druckmesstechnik PD-41, 0-500 mbar) to have an idea of the filtration type. A scheme of the bench test is reported on figure S1A.

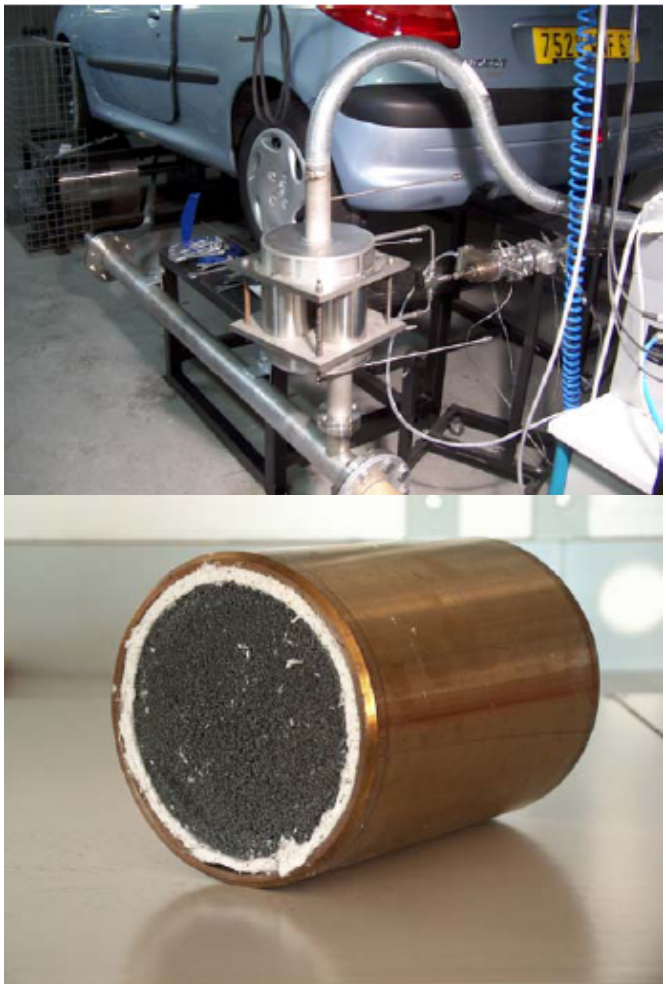

Figure S1. A) Real bench test (Peugeot 206 HDI) ; B) Example of a tested β-SiC foam filter. The white belt is an intumescent product for keeping airtightness and solidity of the foam during the filtration tests.