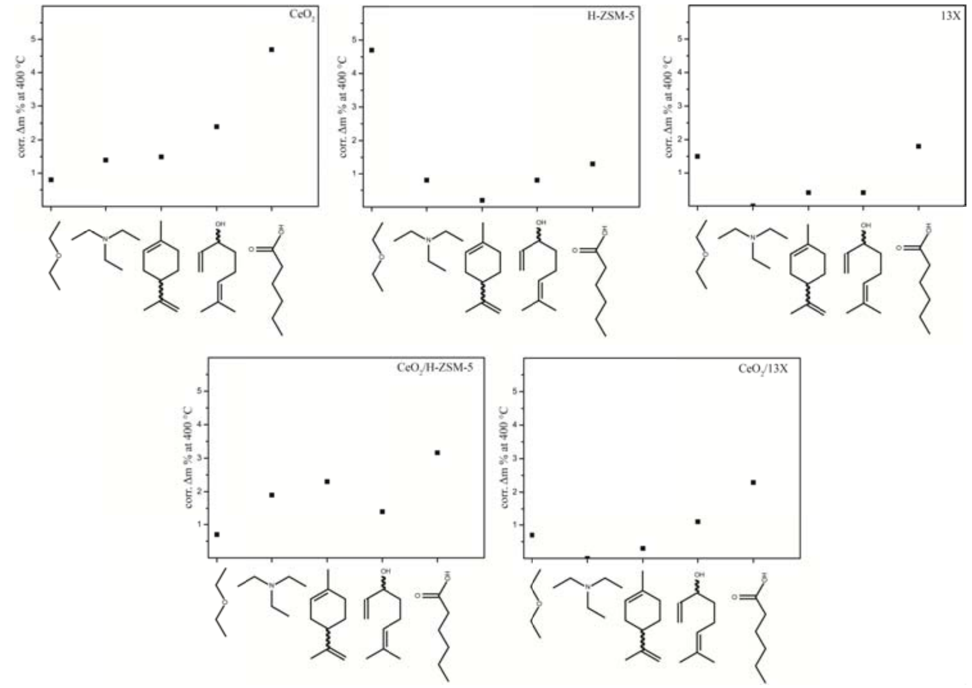
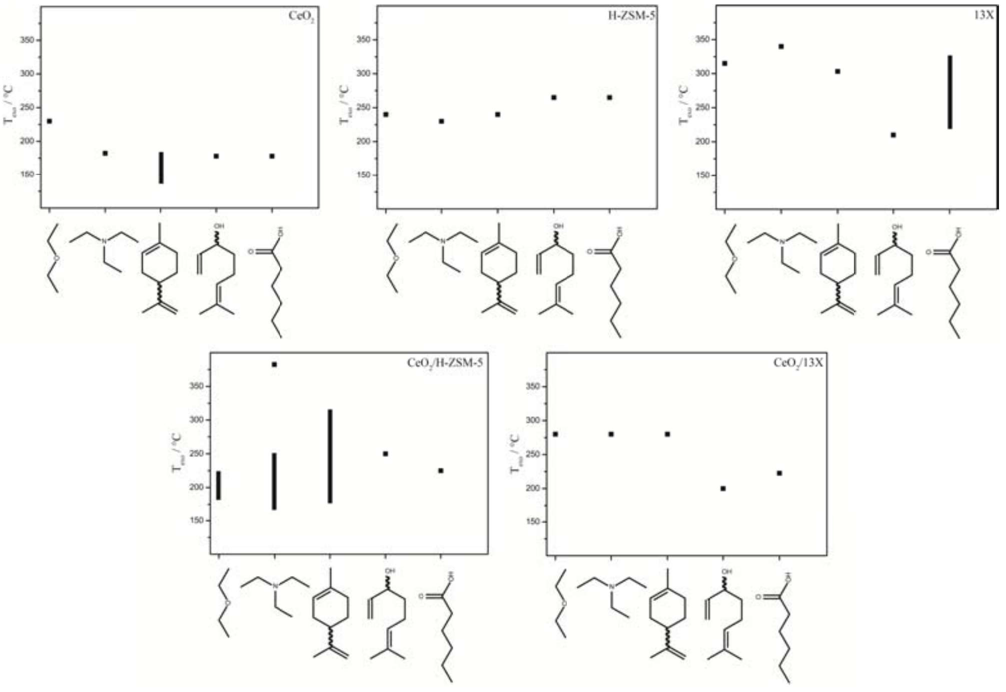
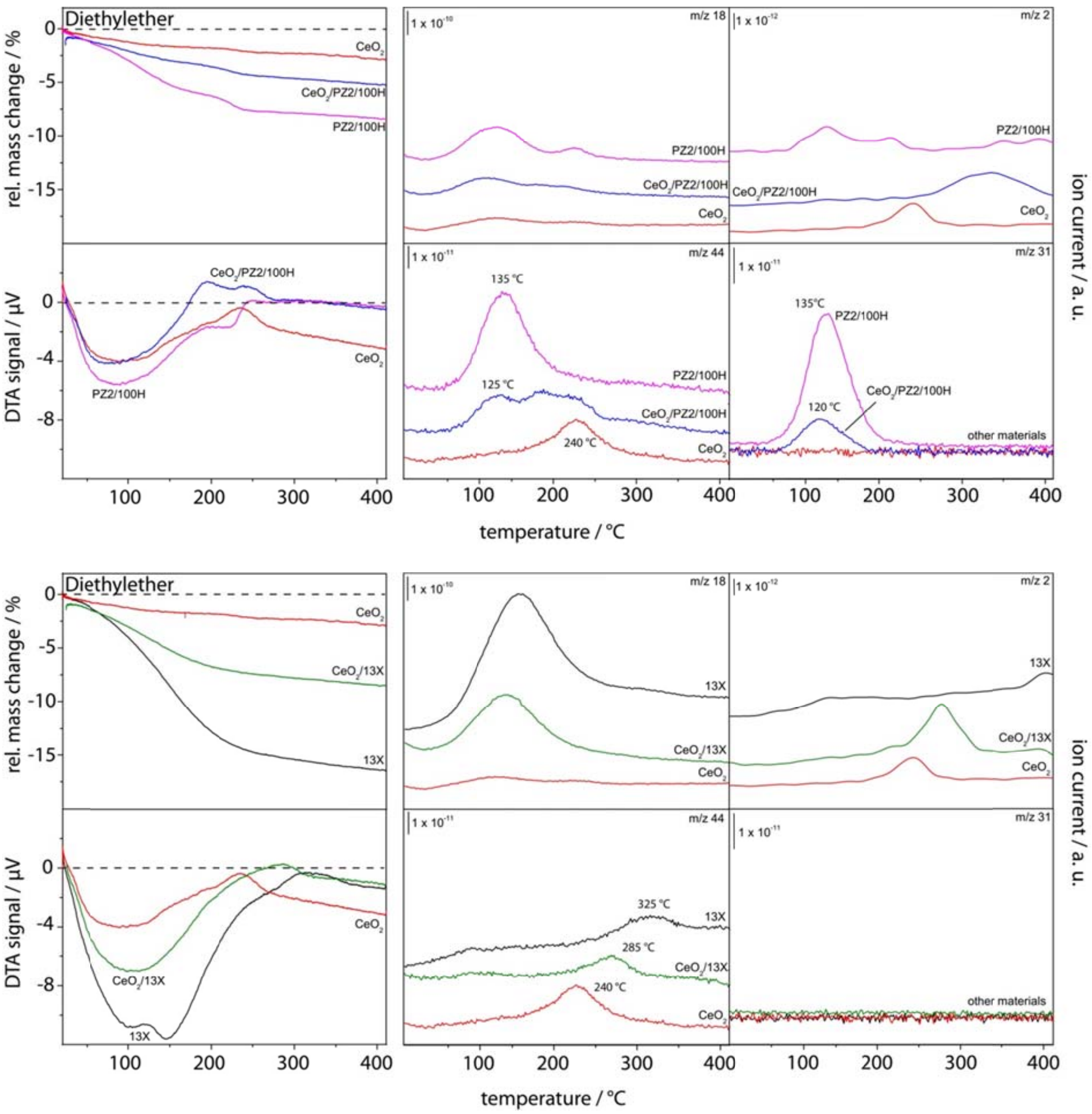
Supporting Information



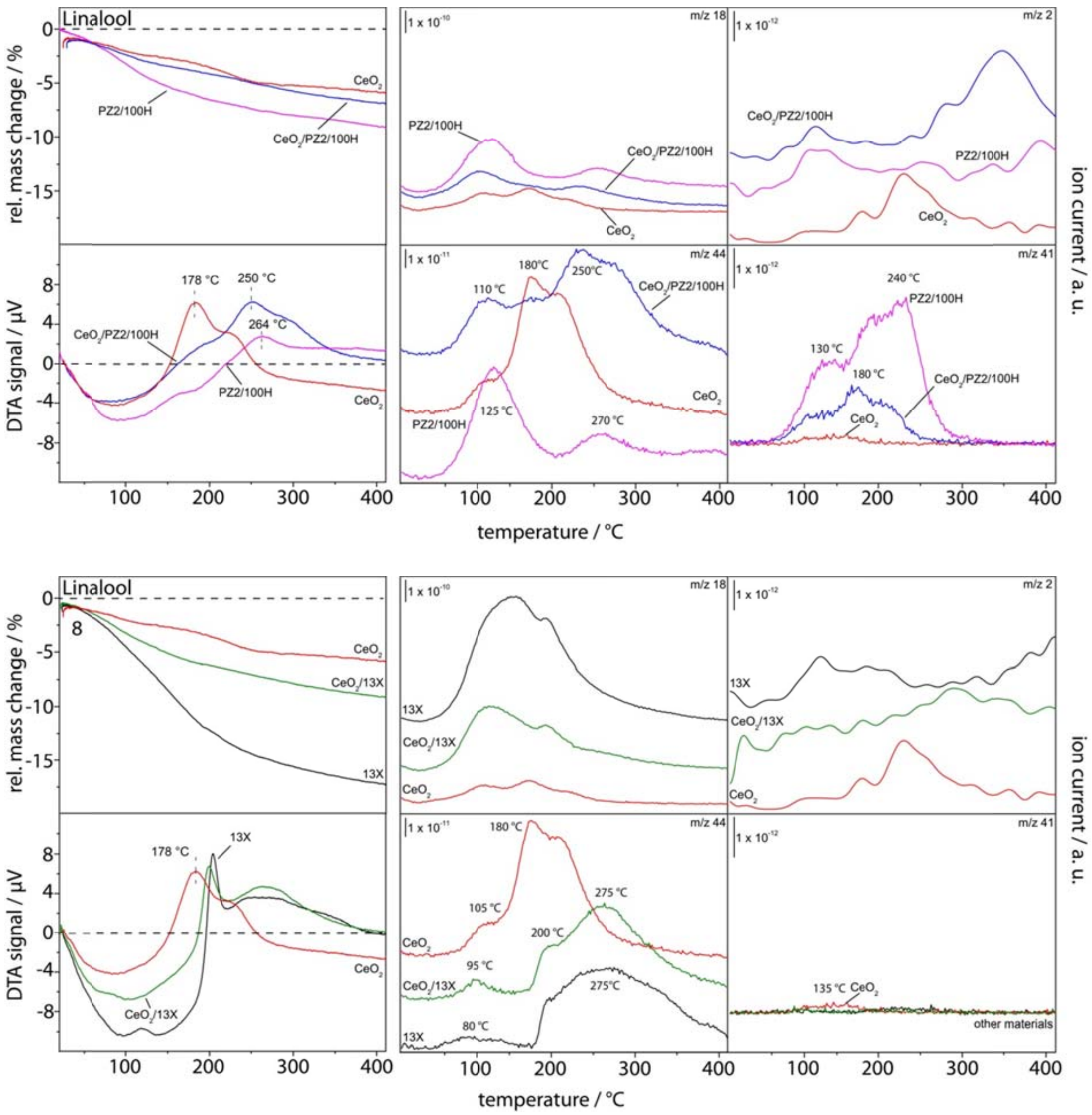
S1: The corrected mass loss at 400 °C ($\Delta m_{400°C}$) is plotted against the adsorbed VOC in wet impregnation experiments. The compounds are listed in order of increasing boiling point. All tested materials (except CeO_2) were milled in water and calcined (1 h/500 °C in air) prior to testing.



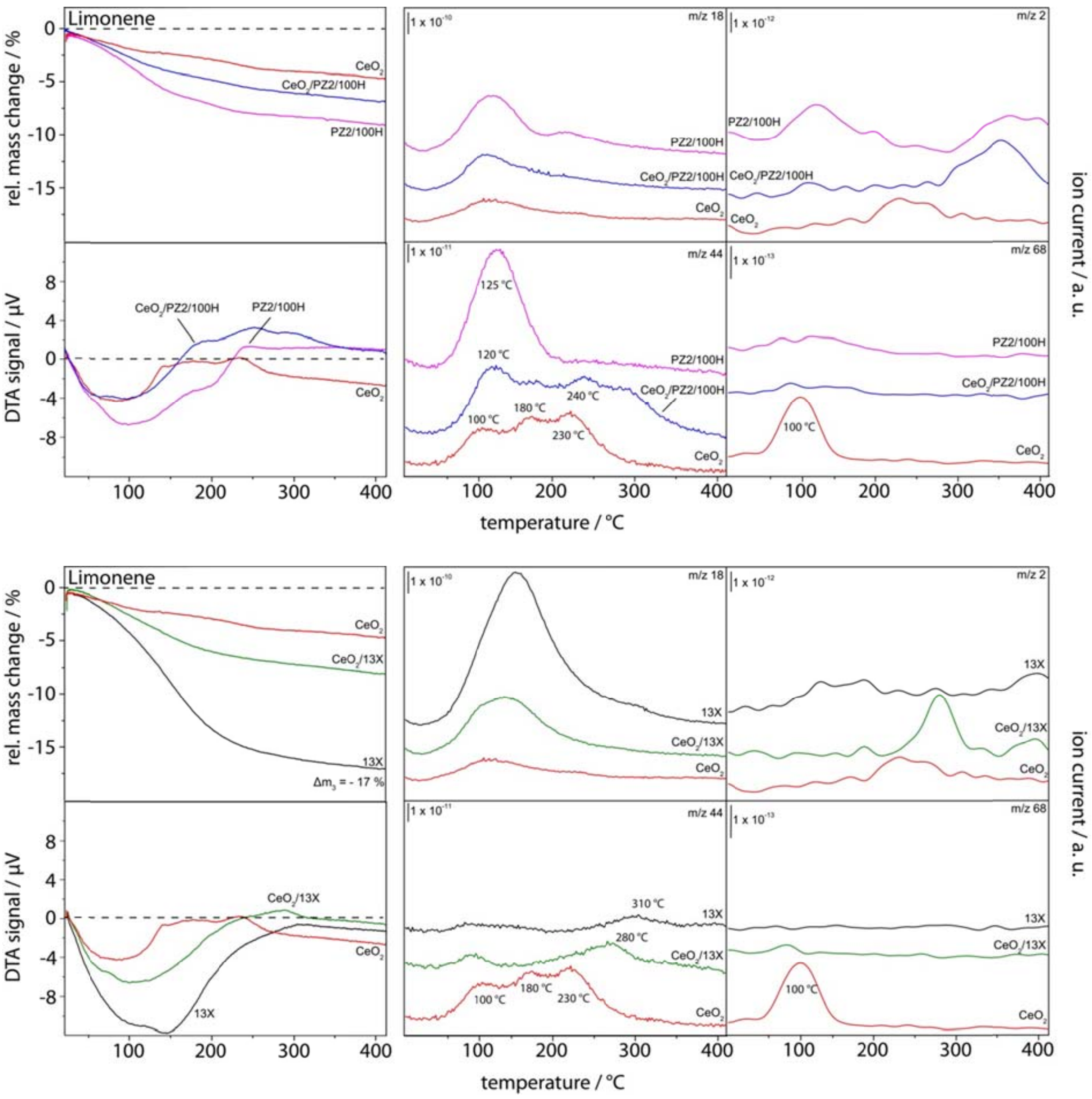
S2: The exothermic peaks in DTA analysis (T_{exo}) is plotted against the adsorbed VOC in wet impregnation experiments. The compounds are listed in order of increasing boiling point. All tested materials (except CeO_2) were milled in water and calcined (1 h/500 °C in air).



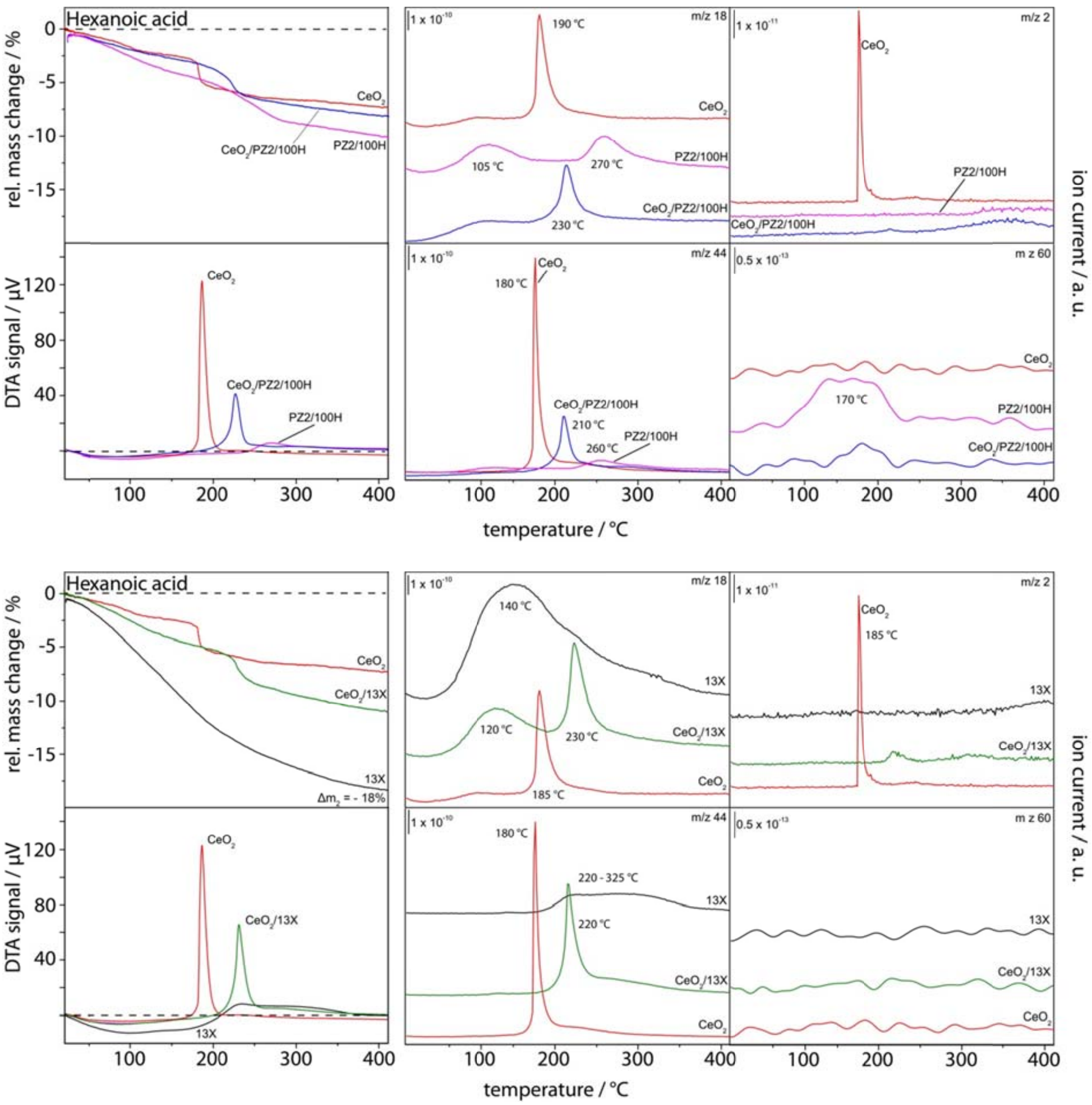
S3: Relative mass loss (top left) and differential thermo analysis signal (bottom left) of diethylether adsorption on five different support materials. Ion current of reaction products (m/z = 18, 44, 2 and 31) evolving during sample heating (right block). All data were collected simultaneously.



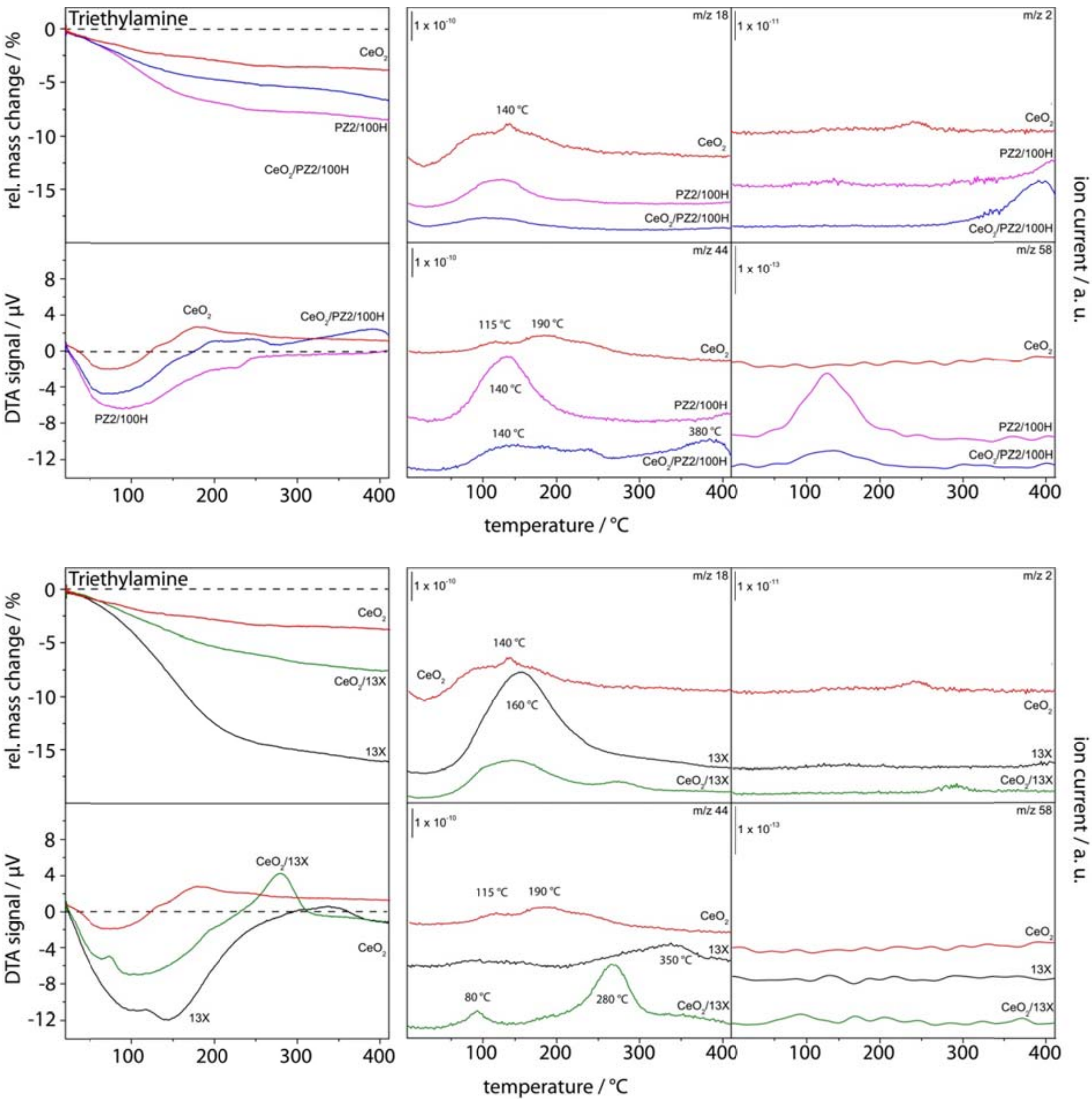
S4: Relative mass loss (top left) and differential thermo analysis signal (bottom left) of linalool adsorption on used support materials. Ion current of reaction products (m/z = 18, 44, 2 and 41) evolving during sample heating (right block). All data were collected simultaneously.



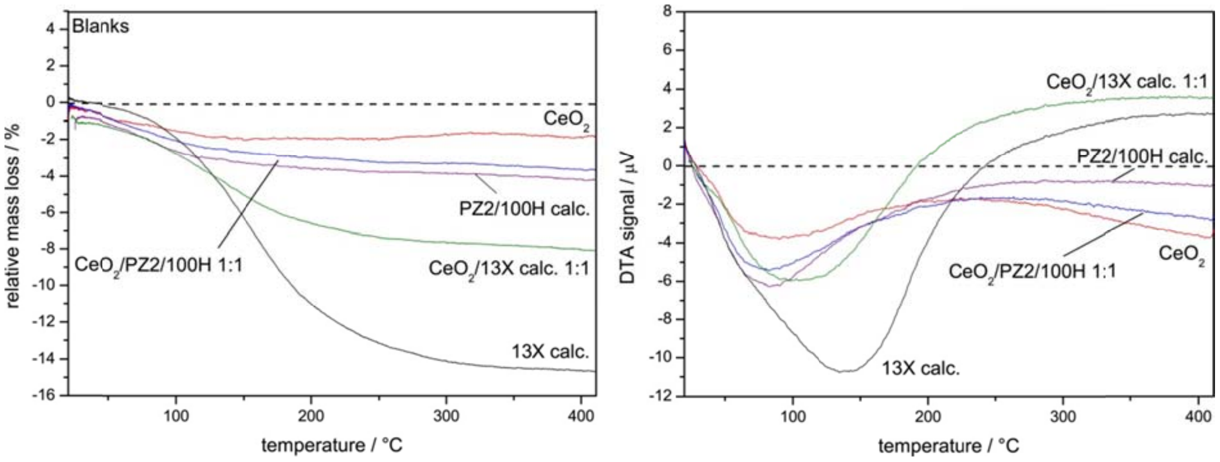
S5: Relative mass loss (top left) and differential thermo analysis signal (top right) of limonene adsorption on used support materials. Ion current of reaction products (m/z = 18, 44, 2 and 68) evolving during sample heating (right block). All data were collected simultaneously.



S6: Relative mass loss (top left) and differential thermo analysis signal (bottom left) of hexanoic acid adsorption on used support materials. Ion current of reaction products (m/z = 18, 44, 2 and 60) evolving during sample heating (right block). All data were collected simultaneously.



S7: Relative mass loss (left) and differential thermo analysis signal (right) of triethylamine adsorption on used support materials. Ion current of reaction products (m/z = 18, 44, 2 and 58) evolving during sample heating (right block). All data were collected simultaneously.

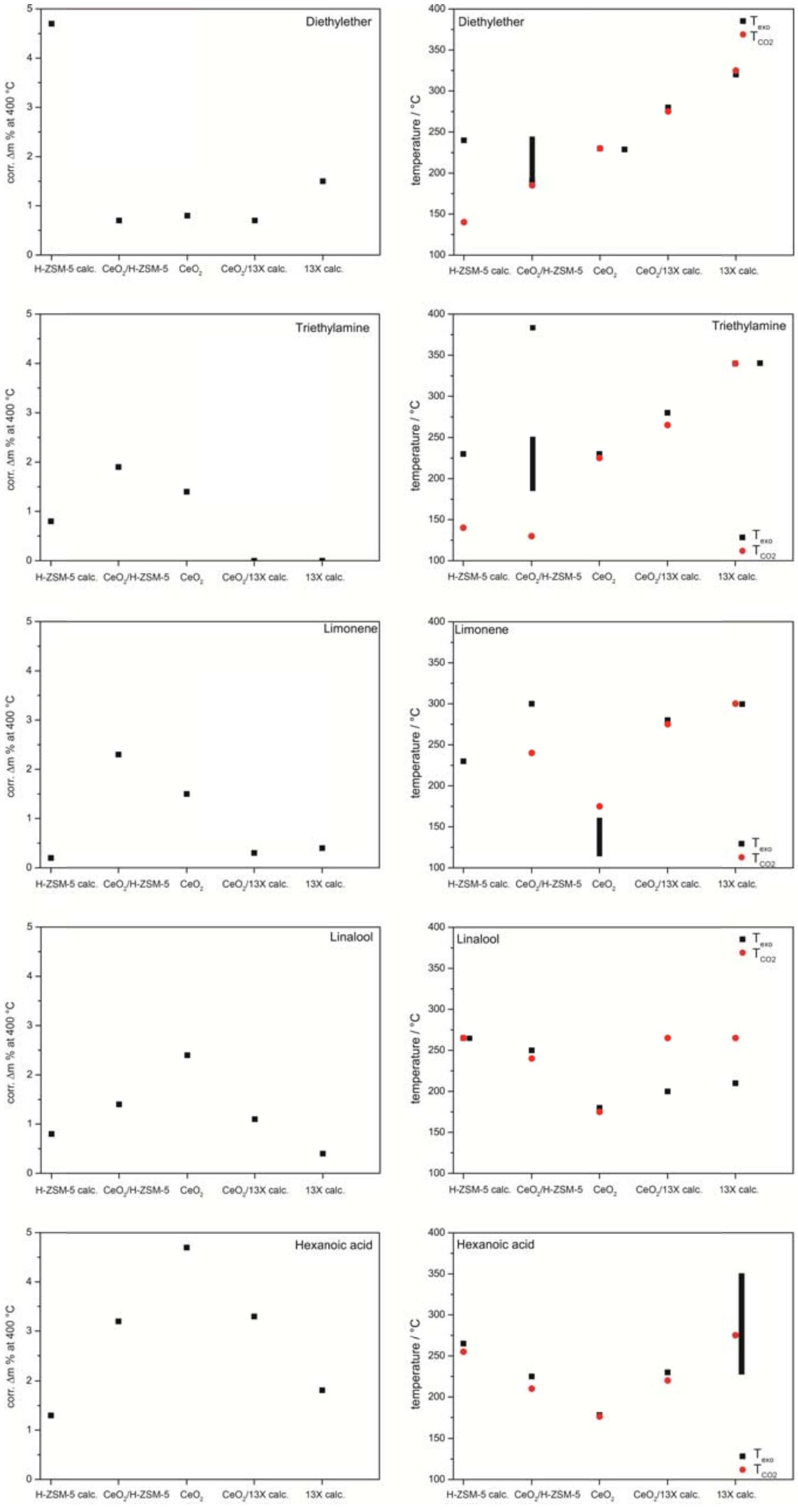


S8: Relative mass loss (left) and differential thermo analysis signal (right) of blanks of five different support materials.

S Table 1

Relative mass loss at 400 °C wet impregnation (raw data)

	Blank	**Diethylether**	**Linalool**	**Limonene**	**Hexanoic acid**	**Triethylamine**
			$-\Delta m_{total}$ [%] 400 °C			
CeO_2	1.7	*2.5*	*4.9*	4	7.2	4.2
CeO_2/H-ZSM-5	3.6	4.3	5.7	6.6	7.5	6.2
H-ZSM-5	3.3	8	8.8	8.2	9.3	8.8
CeO_2/13X calc.	6.8	7.5	8.6	7.8	10.8	7.3
13X calc.	14.5	16	16.4	16.4	17.8	15.8



S9: Left Relative mass loss of wet impregnated adsorber materials with different compounds dissolved in diethylether. **Right:** Exothermic event temperature of adsorbates on different support materials from exothermic peak (DTA) was taken as an indicator for reaction. Additionally CO_2 evolution is plotted. Contributions originating from dietylether (solvent) in samples containing linalool, limonene, hexanoic acid and triethylamine were neglected.

S Table 2
Wet impregnation adsorption data

	$-\Delta m_{total}$ [%] 400 °C [a]	T_{exo} [°C]
Diethylether		
CeO_2	0.8	235
CeO_2/*H-ZSM-5calc.*	0.7	190-240
H-ZSM-5calc.	4.7	240
CeO_2/*13X calc.*	0.7	280
13X calc.	1.5	320
Triethylamine		
CeO_2	1.4	180
CeO_2/*H-ZSM-5calc.*	1.9	180-250/380
H-ZSM-5calc.	0.8	240
CeO_2/*13X calc.*	0.0	280
13X calc.	0.0	340
Limonene		
CeO_2	1.5	140-180
CeO_2/*H-ZSM-5calc.*	2.3	300
H-ZSM-5calc.	0.2	230
CeO_2/*13X calc.*	0.3	280
13X calc.	0.4	300
Linalool		
CeO_2	2.4	*180*
CeO_2/*H-ZSM-5calc.*	1.4	250
H-ZSM-5calc.	0.8	265
CeO_2/*13X calc.*	1.1	200
13X calc.	0.4	210
Hexanoic acid		
CeO_2	4.7	178
CeO_2/*H-ZSM-5calc.*	3.2	230
H-ZSM-5calc.	1.3	265
CeO_2/*13X calc.*	3.3	230
13X calc.	1.8	220-325

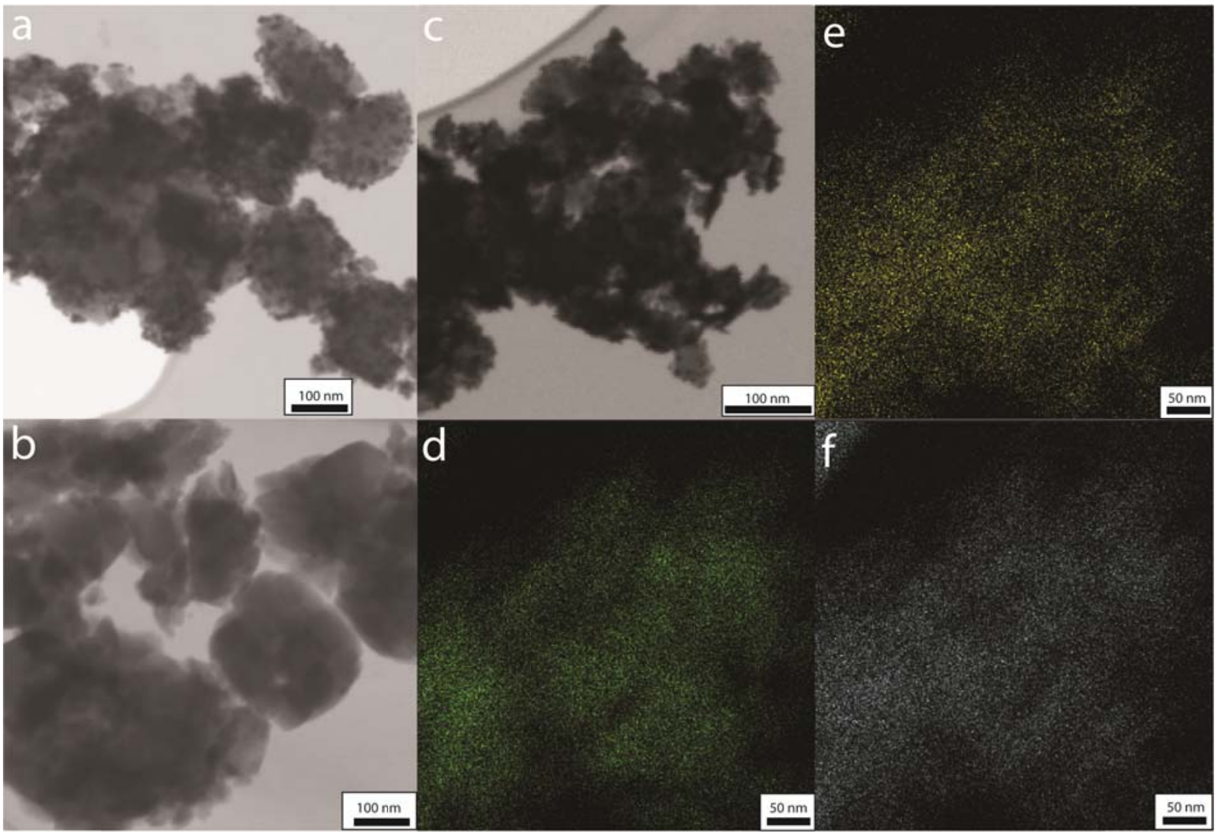
[a] blank and diethylether subtracted

S Table 3

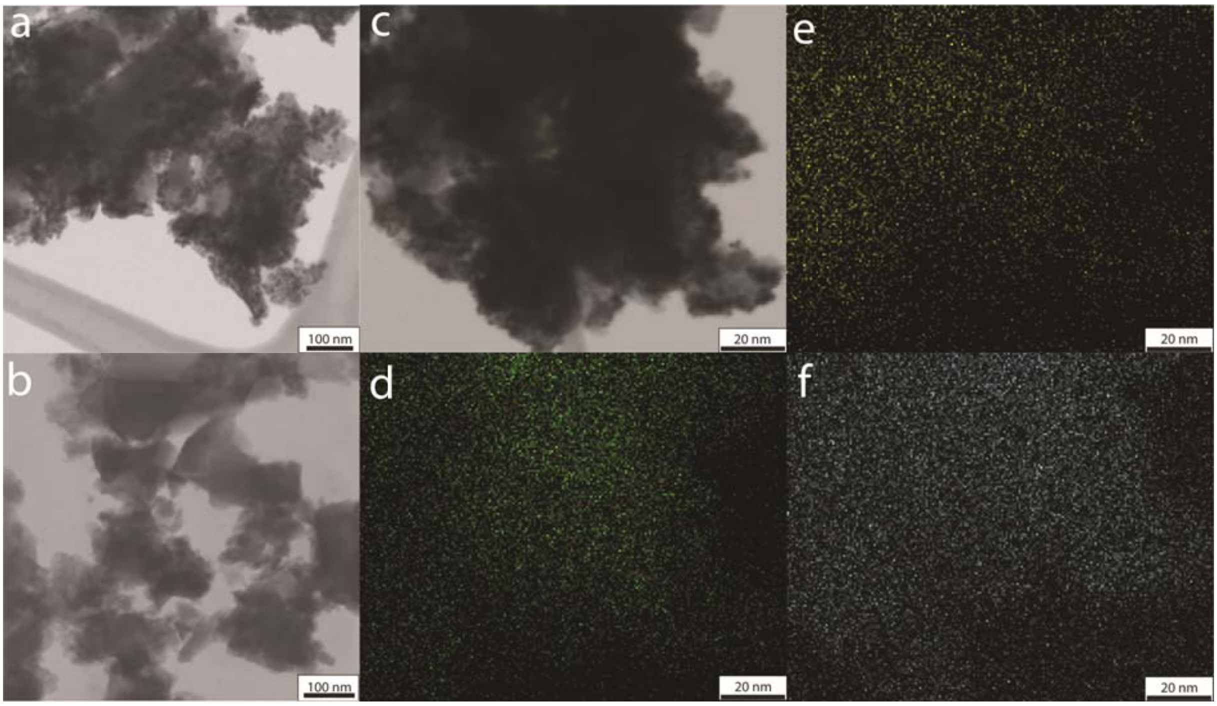
Gas phase adsorption data

	- *Δm_{total} [%]* *400 °C* [a]	**T_{exo}** *[°C]*
Limonene		
CeO_2	3.8	140
CeO_2/H-ZSM-5calc.	4.6	265
H-ZSM-5calc.	6.5	270
CeO_2/13X calc.	2.4	210
13X calc.	3.5	-
Linalool		
CeO_2	3.6	180
CeO_2/H-ZSM-5calc.	3.7	265
H-ZSM-5calc.	2.3	270
CeO_2/13X calc.	3.2	195/255
13X calc.	4	200
Triethylamine		
CeO_2	0.6	175/230
CeO_2/H-ZSM-5calc.	2.4	170/240
H-ZSM-5calc.	2.9	-
CeO_2/13X calc.	2.1	280
13X calc.	2.1	290/340

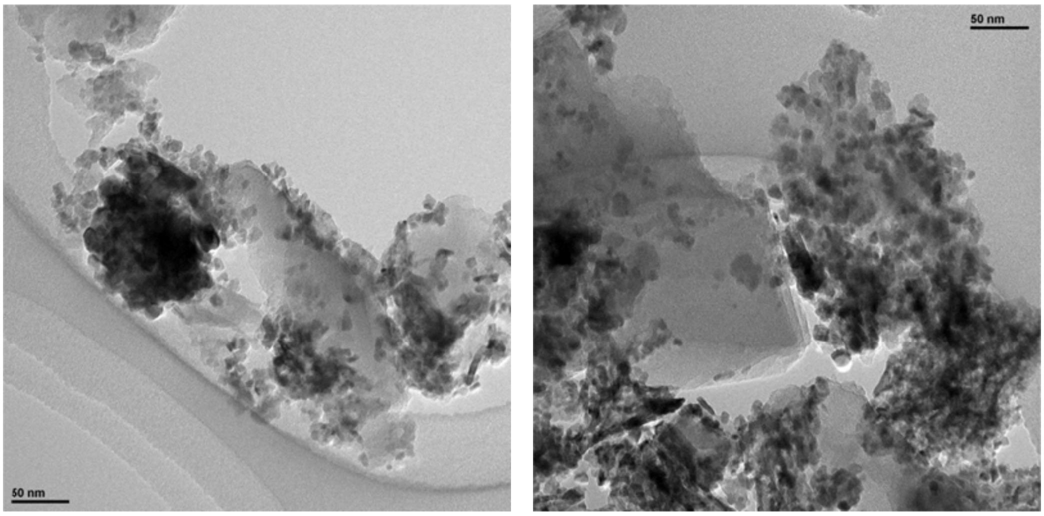
[a] blank subtracted



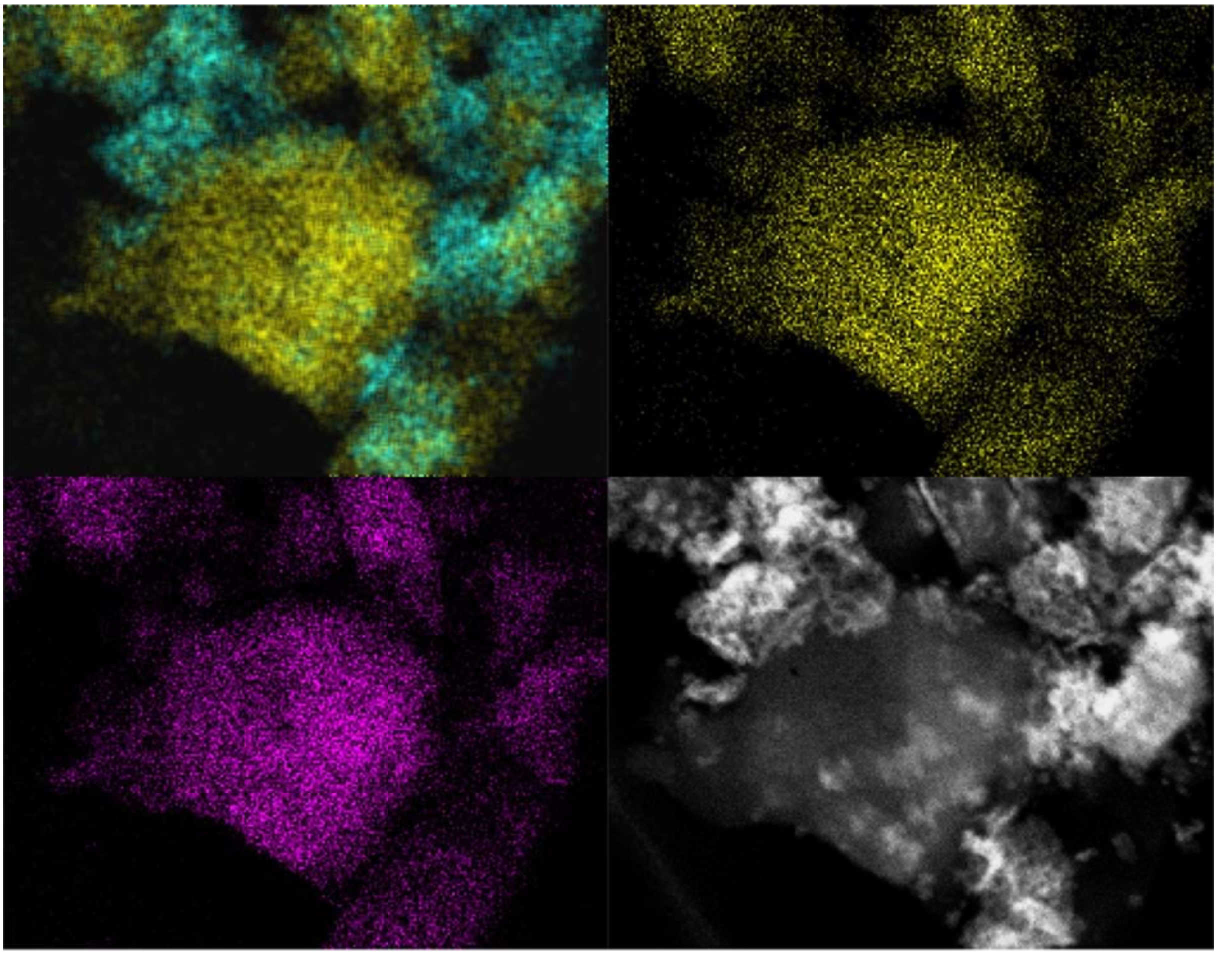
S10: STEM micrographs of CeO_2/H-ZSM-5 (a) and H-ZSM-5 (b) after milling and calcination. EDX mapping region (c) and elemental analysis for cerium (e), oxygen (d) and aluminum (f) of cerium oxide dispersion on H-ZSM-5.



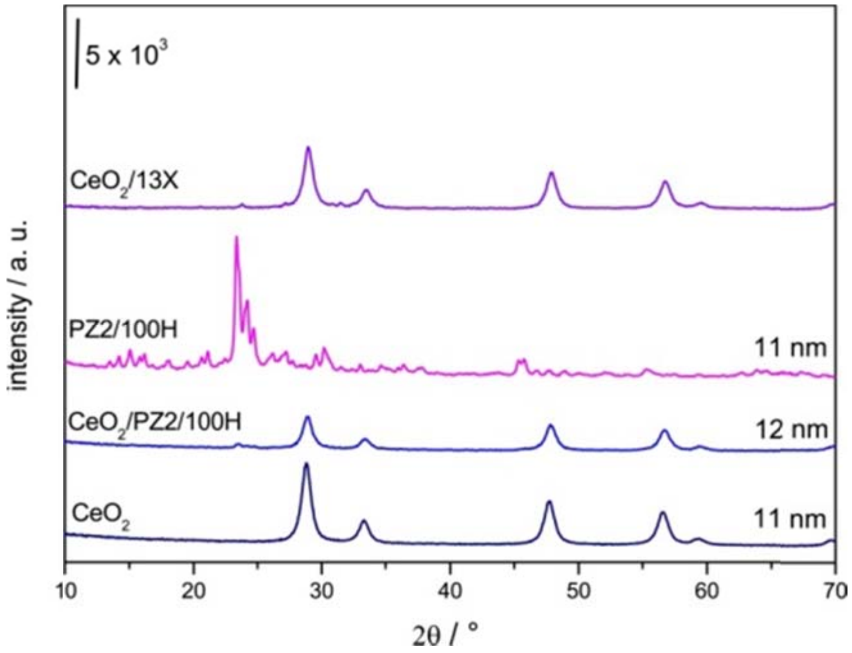
S11: STEM micrographs of CeO_2/13X (a) and 13X (b). EDX mapping region of CeO_2/13X (c), oxygen (d) and aluminum (f) dispersion on 13X.



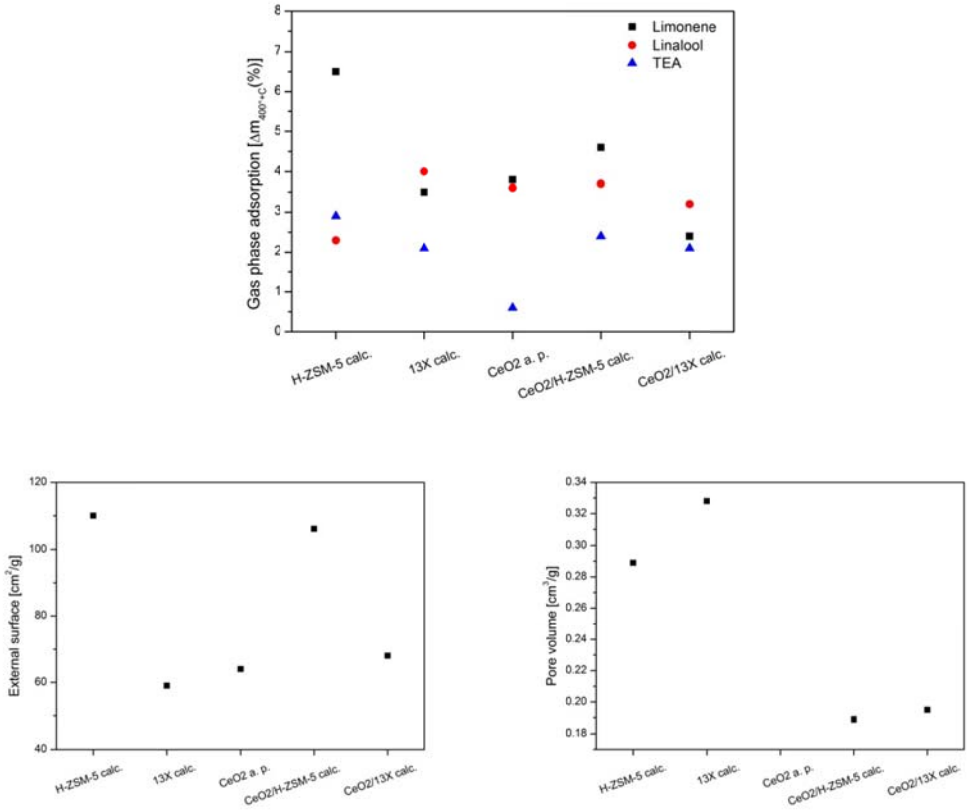
S12: TEM micrographs of CeO_2/H-ZSM-5 (left) and CeO_2/13X (right).



S13: EDX mapping of CeO_2/13X calcined (cyan = Ce, magenta = Si, yellow = aluminum)



S14: XRD pattern of here used materials



S15: Comparison of gas phase adsorption, external surface and pore volume

Cost estimation

A detailed economic study was not performed. However, assuming an average concentration of indoors VOC of 0.5 ppm (equals 2.6 mg/m^3 for an average molecular weight of 130 g/mol) (Huey-Jen Su, Atmospheric Environment 41 (2007) 1230 –1236) and an adsorption capacity of **3 wt. %,** this would correspond to 30 g VOC/kg adsorber. For an average room volume of 50 m^3 (total VOC about 130 mg) this would correspond to about 230 room volumes (230 r. V. /kg adsorber). At this point the adsorber needs to be regenerated. Systems based on activated carbon can adsorb about 10 wt. % (100 g VOC) corresponding to about 770 r. V. /kg adsorber. However, at this point the activated carbon must be replaced or regenerated separately, as regeneration on place would simply release the captured VOC in the environment. This will increment significantly the maintenance costs and the carbon emissions as small amounts of AC are not reactivated but incinerated. Compared to HVAC systems where the indoor air is replaced typically tree times per hour large air volumes must be filtered, cooled or heated in order to assure good indoor air quality. This will further increment the running costs. Additionally, an HVAC system is a complex construction and periodical maintenance is required.

Table 4 Cost estimate for weekly regeneration (2.2 kg adsorber)

Material	Material price [\$/kg]	Adsorber material costs [\$/Adsorber]	Time to exhaustion [d][c]	Cost for one year of operation [\$]
CeO_2/zeolite	20	44	7	144 [a]
Activated carbon	2	4.4	23	816 [b]

[a] assuming 2 service/maintenance
[b] assuming 15 service/exchange plus material
[c] air exchange is 3 room volumes per hour
Service/maintenance costs: 50\$/service

From the table above is visible, that after about 3 cycles (exhaustion/regeneration for CeO_2/zeolite) the acquisition costs are equalized.