Electronic Supplementary Material (ESI) for RSC Advances.

Supporting materials

Mesoporous SnO_2–SiO_2 and Sn–Silica–Carbon nanocomposites by novel non-hydrolytic templated sol-gel synthesis

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GC-MS of byproducts

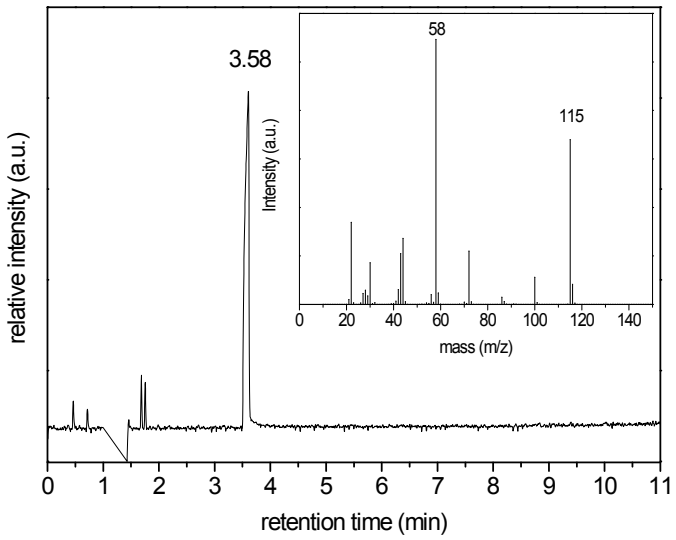

Fig. 1S GC chromatogram and MS spectrum at 3.58 min of $Si(OAc)_4$ + $Sn(NEt_2)_4$ reaction byproducts**.**

TG/DSC curves

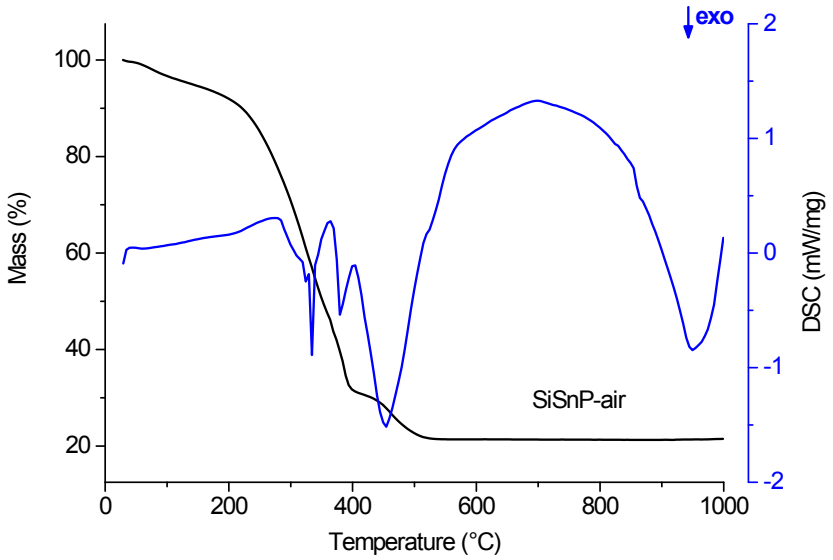

Fig. 2S TG/DSC curves of SiSnP sample. The analysis was performed in air.

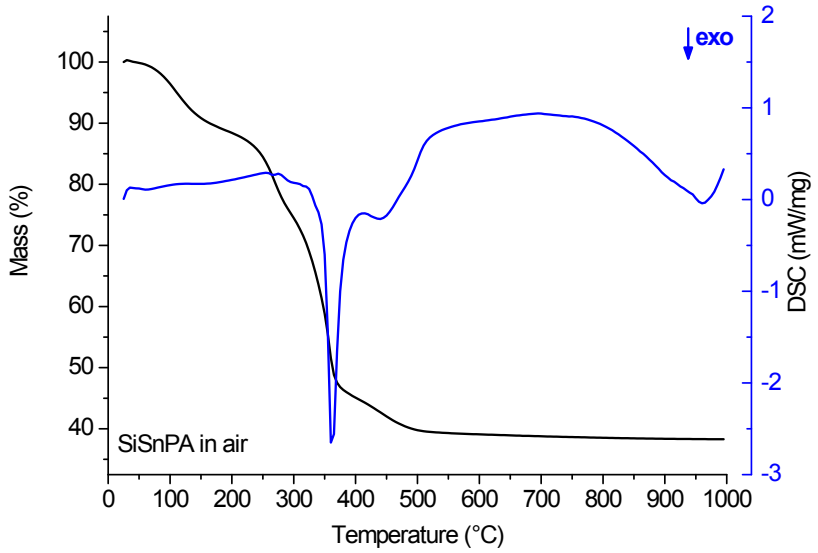

Fig. 3S TG/DSC curves of SiSnPA sample. The analysis was performed in air.

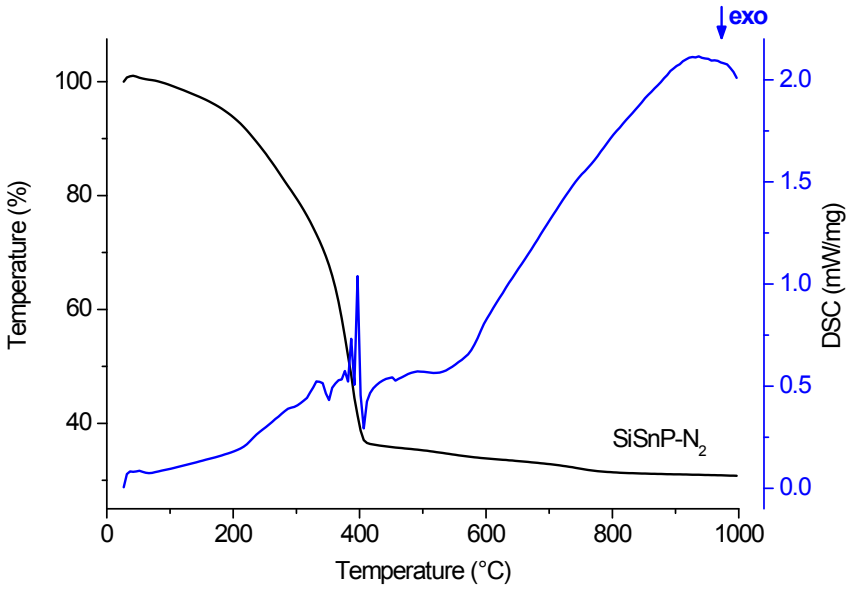

Fig. 4S TG/DSC curves of SiSnP sample. Analyses were performed in N_2.

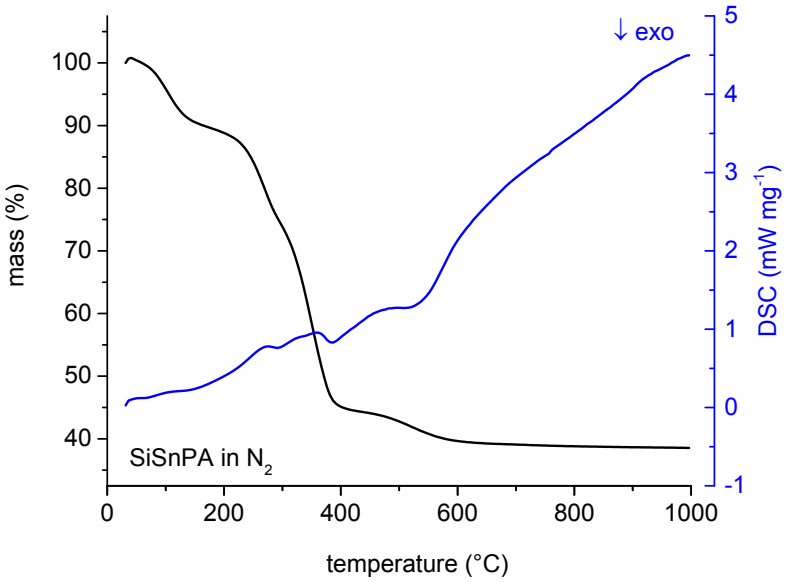

Fig. 5S TG/DSC curves of SiSnPA sample. The analysis was performed in N_2.

HT powder XRD

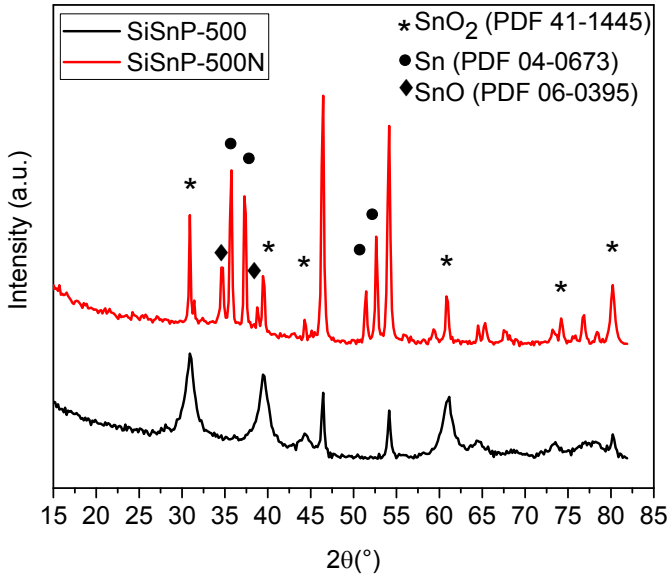

Fig. 6S Powder XRD patterns of SiO_2-SnO_2 nanocomposites SiSnP500 and SiSnP-500N.

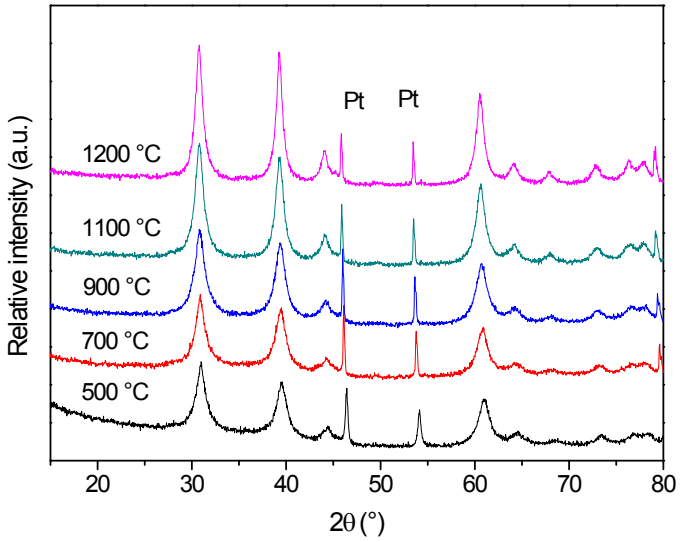

Fig. 7S HT powder XRD patterns of SiO_2-SnO_2 nanocomposite SiSnP with the diffractions of SnO_2 (PDF 41-1445).

Table 1S Size of SnO_2 nanoparticles determined by the Rietveld refinement in SiSnP sample calcined at different temperatures

Temperature [°C]	Size of the crystallites [nm]			
	1,0,0	0,0,1	1,1,0	1,1,1
500	7.33	6.22	7.33	6.68
600	7.27	6.25	7.27	6.68
700	7.51	6.35	7.51	6.82
800	6.96	6.45	6.96	6.68
900	6.75	7.18	6.75	6.97
1000	7.12	8.60	7.12	7.80
1100	8.34	9.10	8.34	8.86
1200	9.99	12.32	9.99	11.32

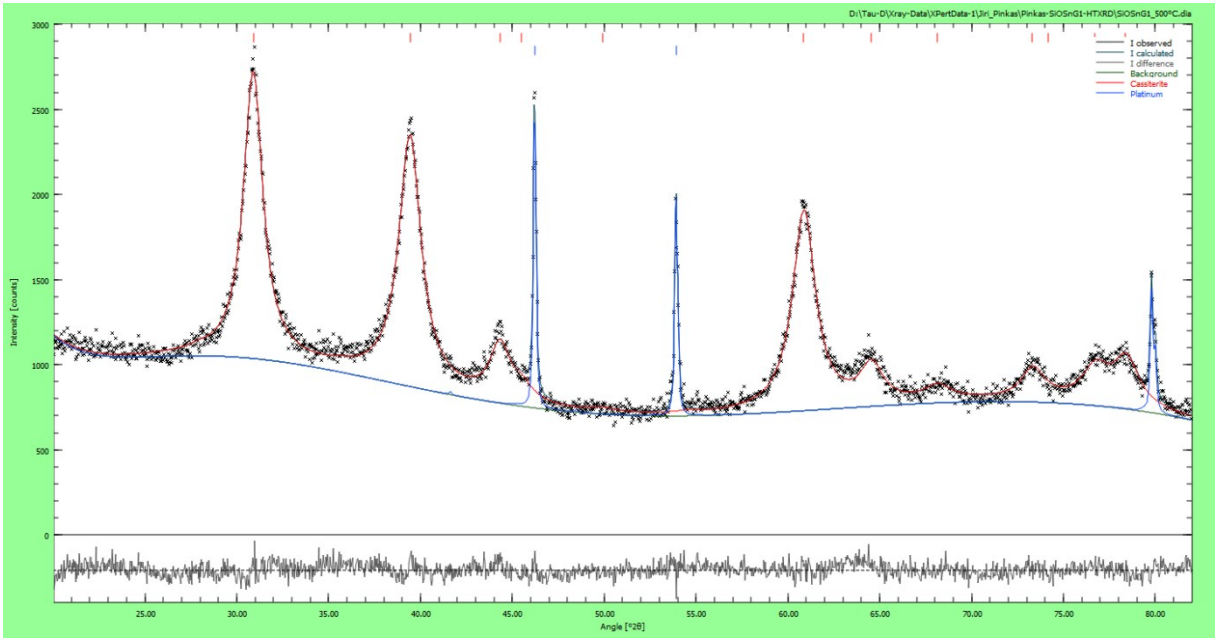

Fig. 8S Rietveld refinement pattern of SiSnP-500.

Rietveld refinement to file(s) SiSnP_500°C.xy
BGMN version 4.2.22, 1855 measured points, 15 peaks, 37 parameters
Rp=3.01% Rpb=14.14% R=3.63% Rwp=3.81% Rexp=3.05%
Durbin-Watson d=1.46
1-rho=1.61%

Global parameters and GOALs
****
cassiterite/sum=ERROR
P/sum=ERROR
EPS2=0.000795+-0.000038

Local parameters and GOALs for phase Cassiterite
****
SpacegroupNo=136
HermannMauguin=P4_2/m2_1/n2/m
XrayDensity=6.997
Rphase=3.34%
UNIT=NM
A=0.473419+-0.000067
C=0.319084+-0.000067
GrainSize(1,0,0)=7.335+-0.094
GrainSize(0,0,1)=6.22+-0.11
GrainSize(1,1,0)=7.335+-0.094
GrainSize(1,1,1)=6.682+-0.070
GEWICHT=SPHAR4, MeanValue(GEWICHT)=0.0848214
B1=ANISOLIN, MeanValue(B1)=0.0614393, sqrt3(det(B1))=0.0611355
Atomic positions for phase Cassiterite
---
 2 0.0000 0.0000 0.0000 E=(SN+4(1.0000))
 4 0.6947 0.6947 0.0000 E=(O-2(1.0000))

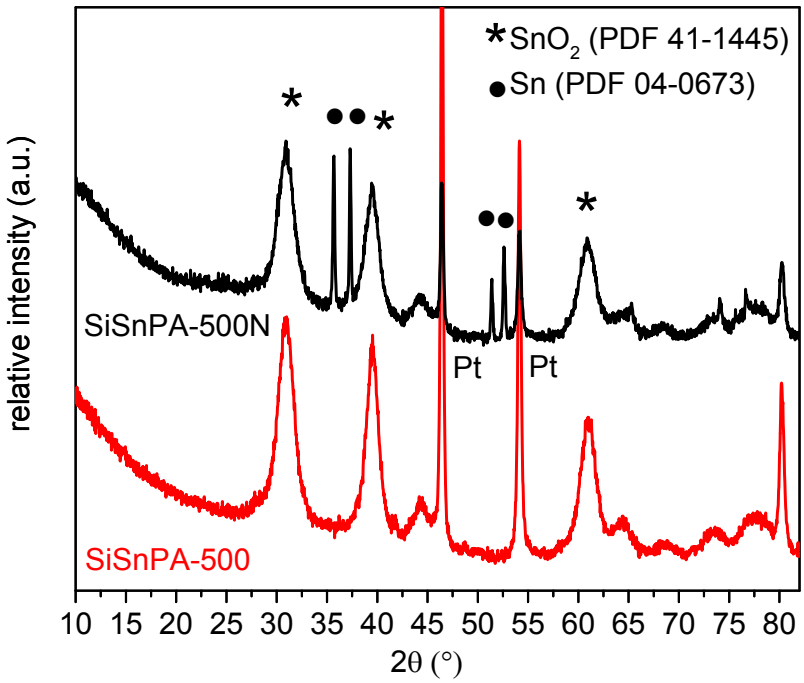

Fig. 9S Powder XRD patterns of SiSnPA-500 and SiSnPA-500N nanocomposites.

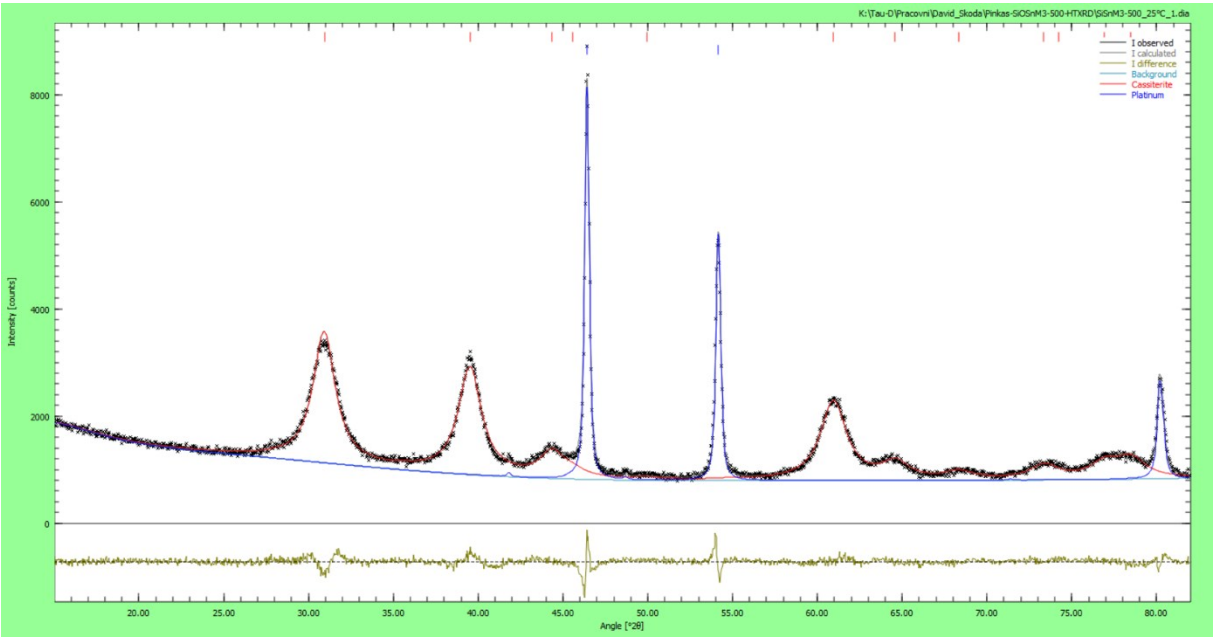

Fig. 10S Rietveld refinement pattern of SiSnPA-500.

Rietveld refinement to file(s) SiSnPA-500.xy
BGMN version 4.2.22, 2005 measured points, 15 peaks, 34 parameters
Rp=3.27% Rpb=11.14% R=4.61% Rwp=4.00% Rexp=2.70%
Durbin-Watson d=0.98
1-rho=0.985%

Global parameters and GOALs
****
240*EPS2/2=0.0765+-0.0040
EPS2=0.000638+-0.000033

Local parameters and GOALs for phase Cassiterite
****
SpacegroupNo=136
HermannMauguin=P4_2/m2_1/n2/m
XrayDensity=7.018
Rphase=4.11%
UNIT=NM
A=0.473260+-0.000068
C=0.318366+-0.000067
k2=0.0000069+-0.0000045
B1=0.0721+-0.0011
GrainSize(1,1,1)=5.890+-0.092
my=0.203889+-0.000065
GEWICHT=SPHAR4, MeanValue(GEWICHT)=0.136657
Atomic positions for phase Cassiterite

2	0.0000	0.0000	0.0000	E=(SN+4(1.0000))
4	0.6947	0.6947	0.0000	E=(O-2(1.0000))

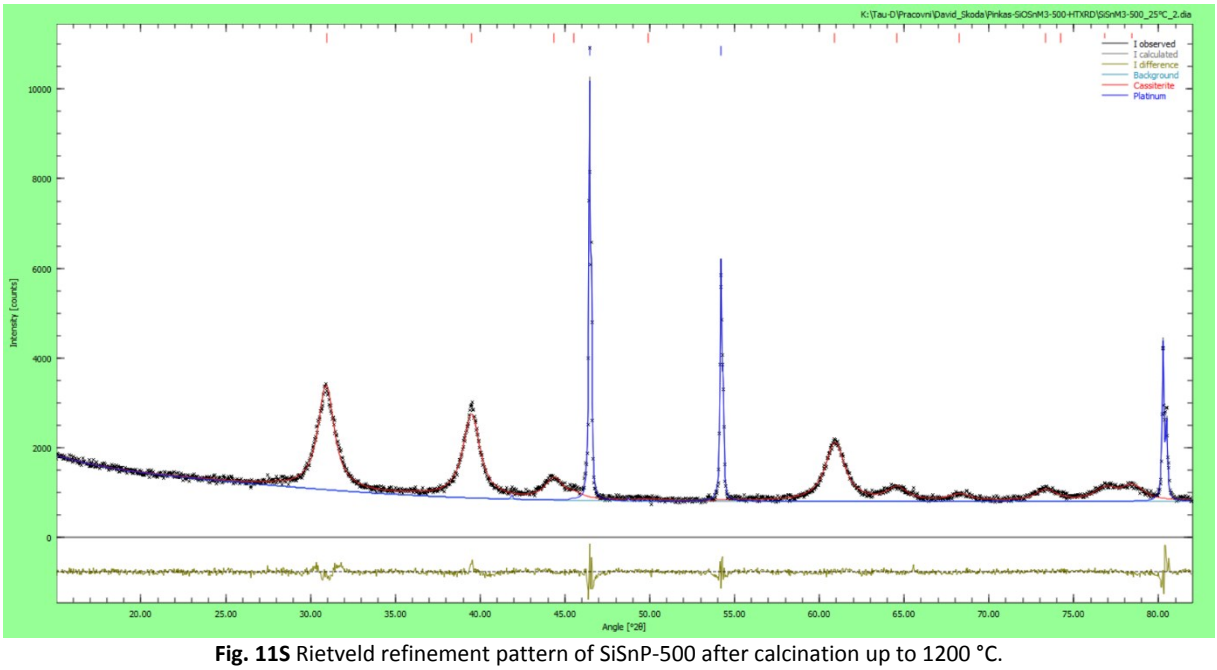

Fig. 11S Rietveld refinement pattern of SiSnP-500 after calcination up to 1200 °C.

Rietveld refinement to file(s) SiSnPA-500_1200°C.xy
BGMN version 4.2.22, 2005 measured points, 15 peaks, 34 parameters
Rp=3.16% Rpb=14.09% R=4.62% Rwp=3.93% Rexp=2.87%
Durbin-Watson d=1.36
1-rho=1.12%

Global parameters and GOALs
****
240*EPS2/2=0.0594+-0.0017
EPS2=0.000495+-0.000014

Local parameters and GOALs for phase Cassiterite
****
SpacegroupNo=136
HermannMauguin=P4_2/m2_1/n2/m
XrayDensity=7.004
Rphase=3.74%
UNIT=NM
A=0.473489+-0.000049
C=0.318699+-0.000052
k2=0.0000080+-0.0000031
B1=0.05079+-0.00085
GrainSize(1,1,1)=8.36+-0.14
my=0.203478+-0.000043
GEWICHT=SPHAR4, MeanValue(GEWICHT)=0.0933681
Atomic positions for phase Cassiterite

2	0.0000	0.0000	0.0000	E=(SN+4(1.0000))
4	0.6947	0.6947	0.0000	E=(O-2(1.0000))

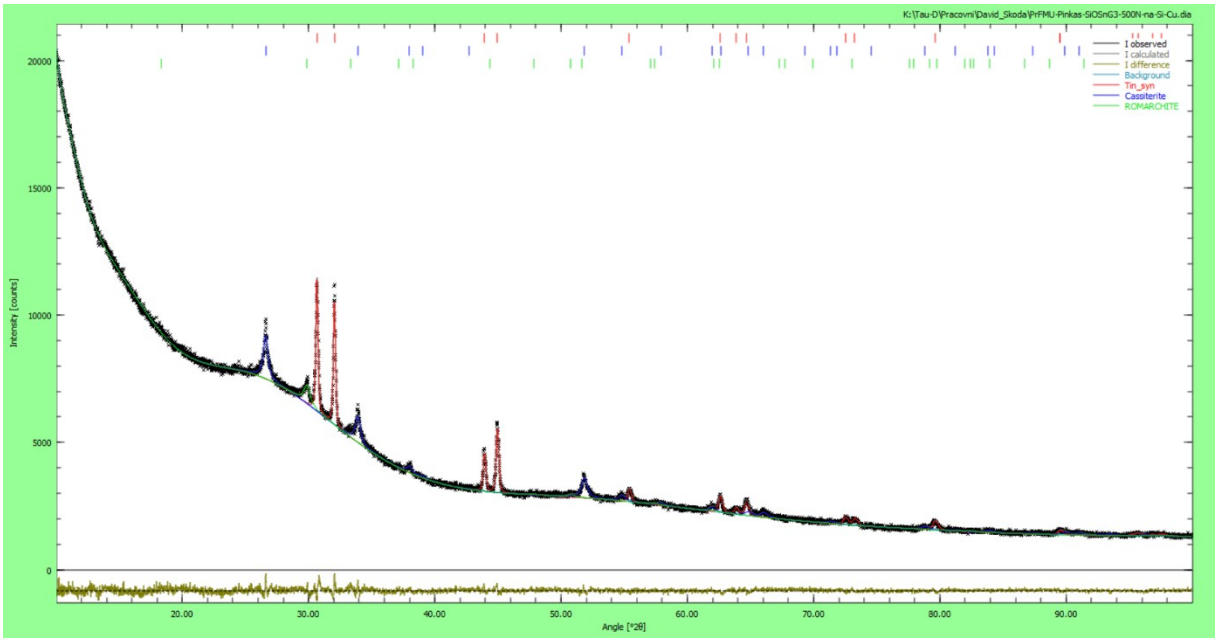

Fig. 12S Rietveld refinement pattern of SiSnF-500N.

Rietveld refinement to file(s) SiOSnF-500N.xy
BGMN version 4.2.22, 6854 measured points, 77 peaks, 70 parameters
Rp=1.38% Rpb=39.71% R=1.47% Rwp=1.88% Rexp=1.53%
Durbin-Watson d=1.31
1-rho=0.160%

Global parameters and GOALs
****
tin/sum=0.5587+-0.0047
cassiterite/sum=0.3794+-0.0049
romarchite/sum=0.0618+-0.0051
240*EPS2/2=ERROR

Local parameters and GOALs for phase Tin_syn
****
SpacegroupNo=141
HermannMauguin=I4_1/a2/m2/d
XrayDensity=7.309
Rphase=2.94%
UNIT=NM
A=0.582520+-0.000013
C=0.317844+-0.000010
k2=0.00000505+-0.00000043
B1=0.00291+-0.00024
GrainSize(1,1,1)=146+-12
my=0.1805331+-0.0000079
GEWICHT=SPHAR4, MeanValue(GEWICHT)=0.0296591
Atomic positions for phase Tin_syn
---
 4   0.0000 0.0000 0.0000   E=(SN(1.0000))

Local parameters and GOALs for phase Cassiterite
****
SpacegroupNo=136
HermannMauguin=P4_2/m2_1/n2/m
XrayDensity=7.018
Rphase=2.48%
UNIT=NM
A=0.473275+-0.000046
C=0.318318+-0.000058
k2=0.0000022+-0.0000013
B1=0.02112+-0.00083
GrainSize(1,1,1)=20.09+-0.79
my=0.138258+-0.000027
GEWICHT=SPHAR4, MeanValue(GEWICHT)=0.0207914
Atomic positions for phase Cassiterite
---
 2   0.0000 0.0000 0.0000   E=(SN+4(1.0000))
 4   0.6947 0.6947 0.0000   E=(O-2(1.0000))

Local parameters and GOALs for phase ROMARCHITE
****

SpacegroupNo=129
HermannMauguin=P4/n2_1/m2/m
XrayDensity=6.408
Rphase=2.12%
UNIT=NM
k2=0
B1=0.0300000
GrainSize(1,1,1)=14.1471
my=0.140348
GEWICHT=SPHAR4, MeanValue(GEWICHT)=0.00338229
Atomic positions for phase ROMARCHITE
---
2 0.0000 0.0000 0.0000 E=(O-2(1.0000))
2 0.0000 0.5000 0.2345 E=(SN+2(1.0000))

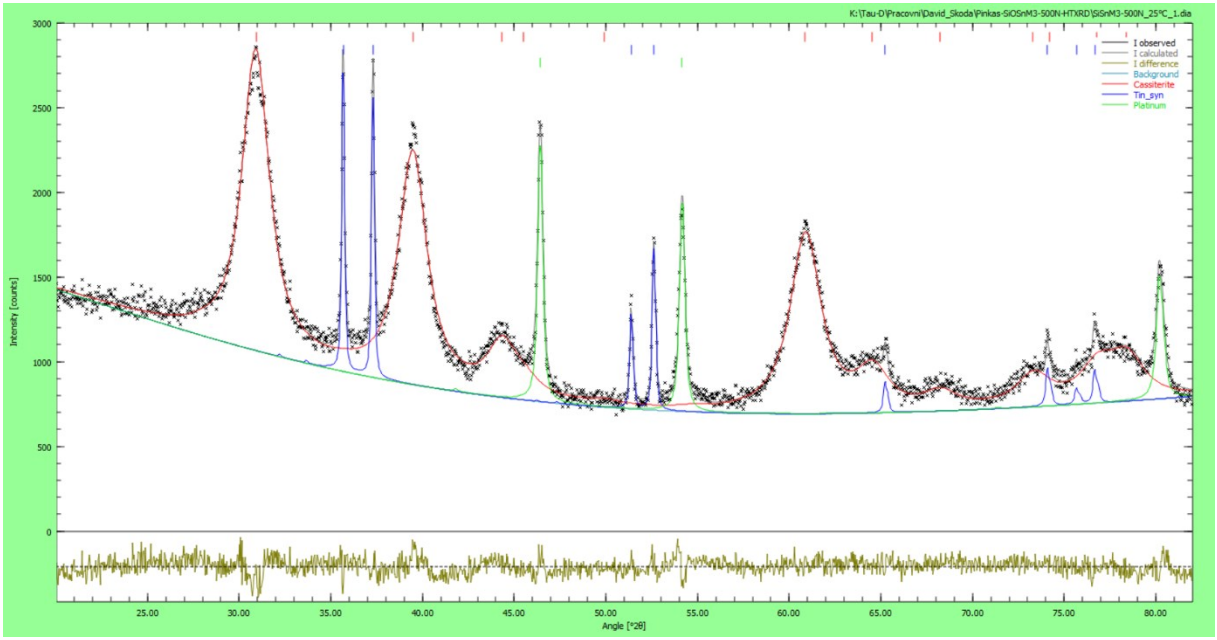

Fig. 13S Rietveld refinement pattern of SiSnPA-500N.

Rietveld refinement to file(s) SiSnPA-500N.xy
Rp=3.16% Rpb=11.84% R=3.81% Rwp=3.92% Rexp=2.89%
Durbin-Watson d=1.25
1-rho=1.49%

Global parameters and GOALs
****
cassiterite/sum=0.9036+-0.0018
tin/sum=0.0964+-0.0018
240*EPS2/2=0.0653+-0.0044
EPS2=0.000544+-0.000037

Local parameters and GOALs for phase Cassiterite
****
SpacegroupNo=136

HermannMauguin=P4_2/m2_1/n2/m
XrayDensity=6.997
Rphase=3.65%
UNIT=NM
A=0.473588+-0.000082
C=0.318865+-0.000082
k2=0
B1=0.0726+-0.0030
k1=0.177+-0.087
GrainSize(1,1,1)=5.333+-0.057
my=0.203287+-0.000076
GEWICHT=SPHAR4, MeanValue(GEWICHT)=0.101946
Atomic positions for phase Cassiterite
---
 2 0.0000 0.0000 0.0000 E=(SN+4(1.0000))
 4 0.6947 0.6947 0.0000 E=(O-2(1.0000))

Local parameters and GOALs for phase Tin_syn
****
SpacegroupNo=141
HermannMauguin=I4_1/a2/m2/d
XrayDensity=7.291
Rphase=3.81%
UNIT=NM
A=0.582993+-0.000057
C=0.318117+-0.000034
k2=0.00000063+-0.00000034
B1=0.00395+-0.00037
GrainSize(1,1,1)=107+-10
my=0.265389+-0.000073
GEWICHT=SPHAR4, MeanValue(GEWICHT)=0.0103778
Atomic positions for phase Tin_syn
---
 4 0.0000 0.0000 0.0000 E=(SN(1.0000))

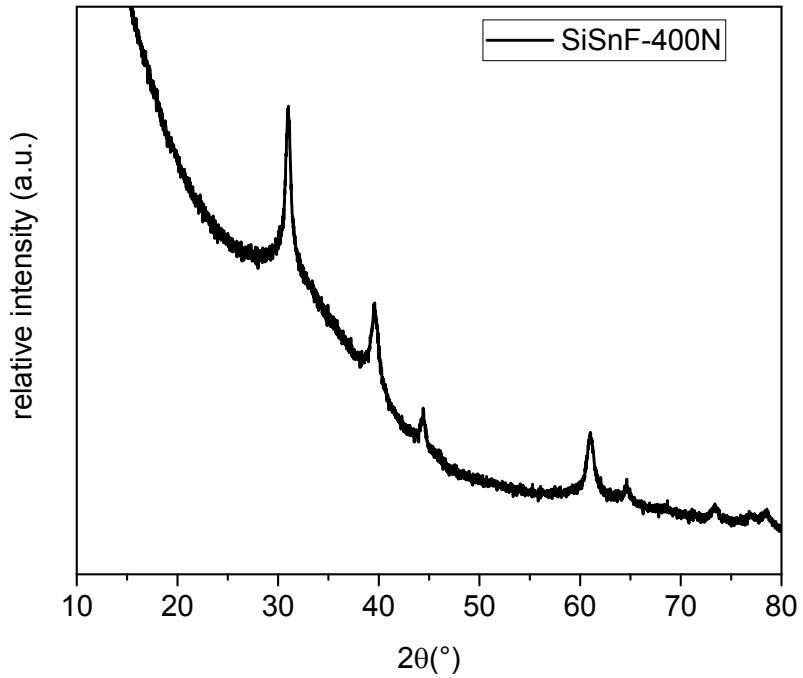

Fig. 14S Powder XRD diffractogram of the sample SiSnF-400N. The diffractions correspond to SnO_2 (PDF 41-1445).

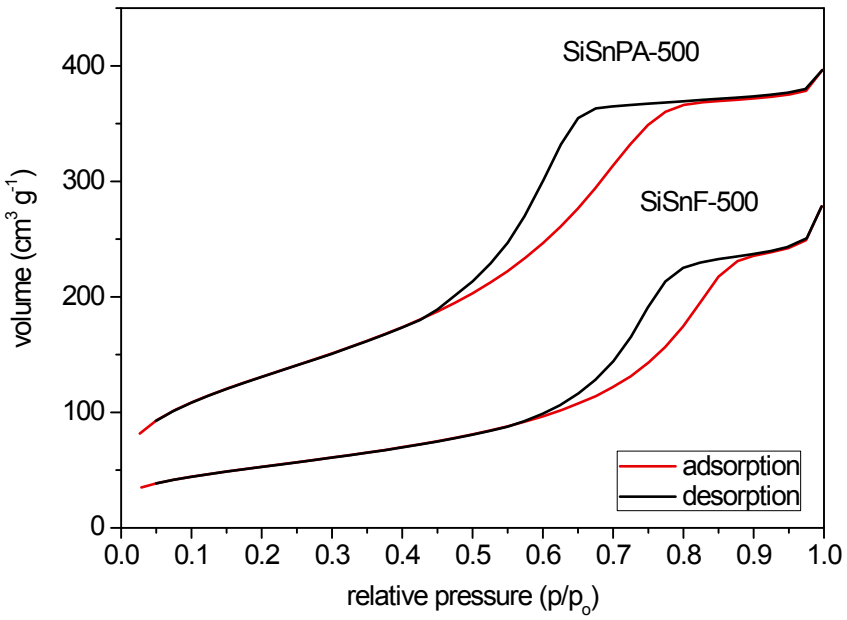

Fig. 15S N_2 adsorption/desorption isotherms of air calcined xerogels. SiSnPA-500 sample (top) prepared in an autoclave, SiSnF-500 (bottom) prepared with the Schlenk technique.

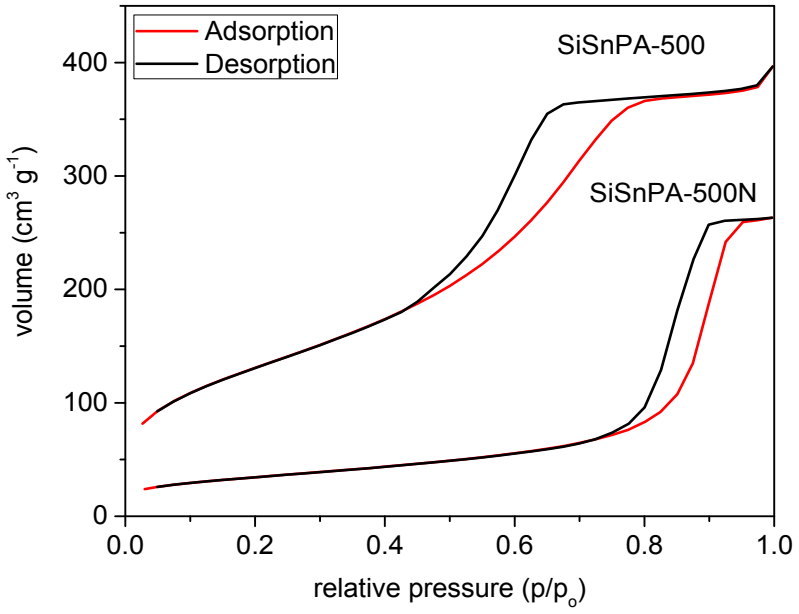

Fig. 16S N_2 adsorption/desorption isotherms of air calcined xerogels. SiSnPA-500 sample (top) calcined in air and SiSnPA-500N sample heated under N_2.

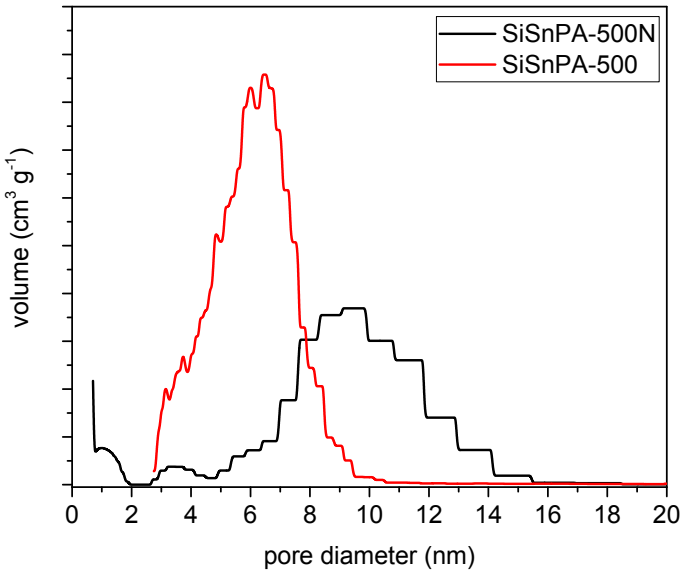

Fig. 17S Pore size distributions based on NLDFT (asdorption branch) (red) and QSDFT (black) models.

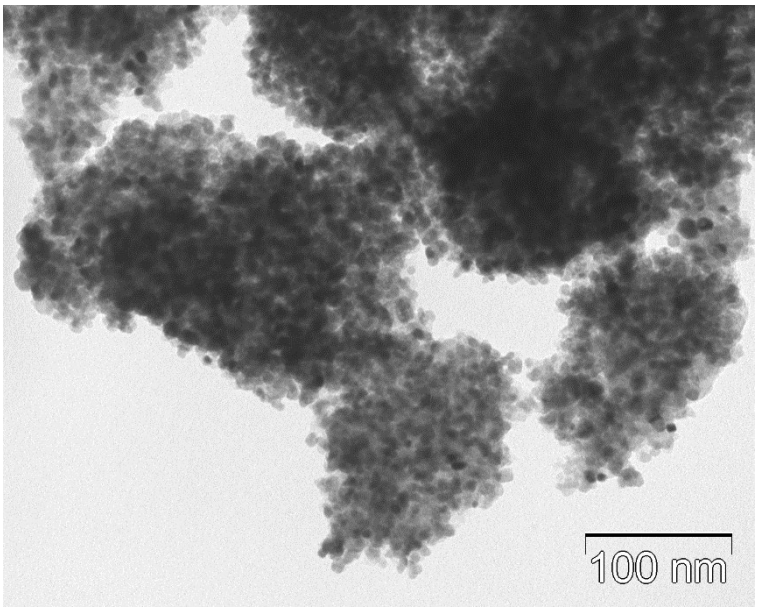

Fig. 18S TEM image of SiSnPA-500 xerogel.

Pyridine adsorption

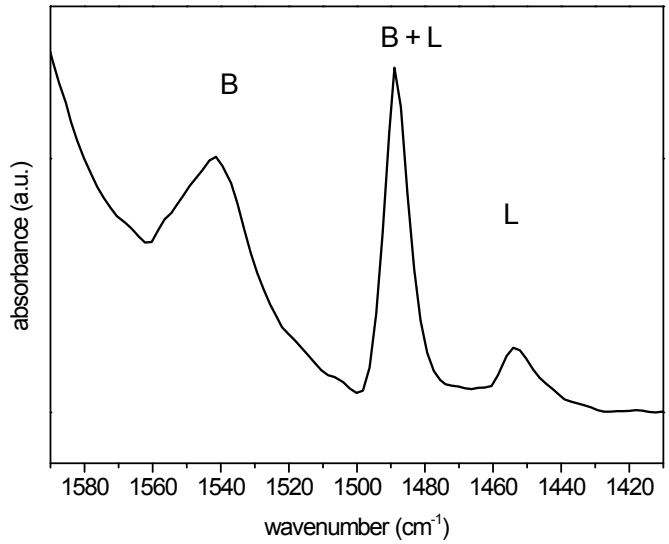

Fig. 19S IR spectrum of calcined SiSnP-500 xerogel after pyridine adsorption.

Catalysis

Aminolysis of styrene oxide

Conditions: 25 mg of calcined SnO_2-SiO_2 xerogel, 5 mmol of substrates, 5 cm^3 of toluene, 50 °C.

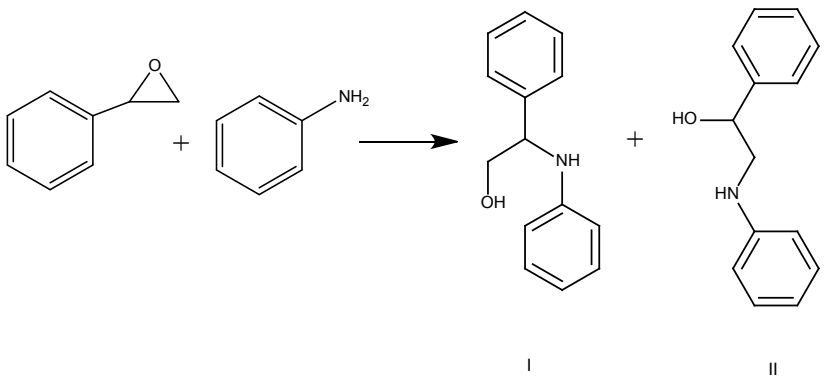

Fig. 20S Aminolysis of styrene oxide with aniline.

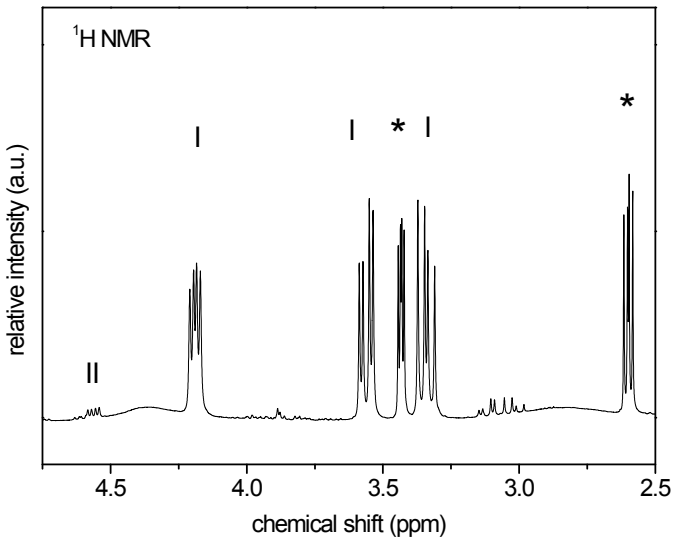

Fig. 21S ^{1}H NMR spectrum of a reaction mixture after aminolysis reaction.

MPV reduction of 4-*tert*-butylcyclohexanone

Conditions: 25 mg of calcined SnO_2-SiO_2 xerogel, 500 mg (3.54 mmol) of 4-*tert*-butylcyclohexanone, 15 cm^3 (196 mmol) of dry 2-propanol, and 0.100 cm^3 of nonane as an internal standard. Reaction mixture was refluxed for 1 h.

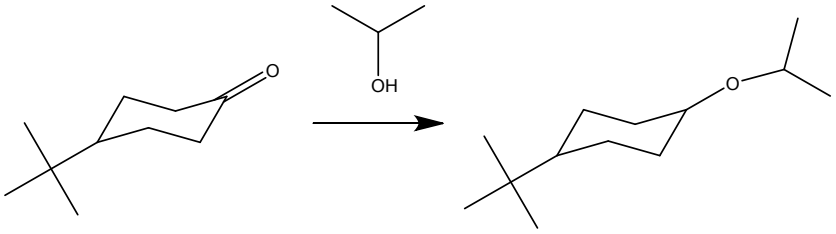

Fig. 22S MPV reduction of 4-*tert*-butylcyclohexanone in isopropanol.

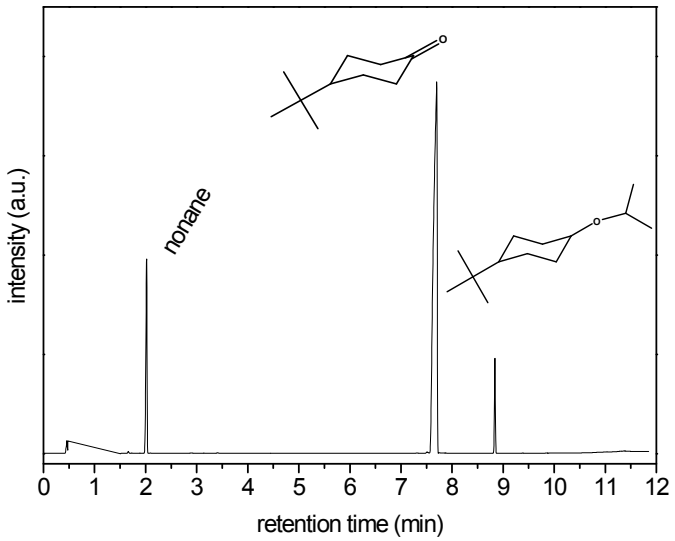

Fig. 23S GC chromatogram of reaction products in the MPV reduction.