catalysts

MDPI

Article

Supplementary Materials: Probing the Surface Acidity of Supported Aluminum Bromide Catalysts

1. DRIFTS results

FT-IR DRIFTS results for the three different silica supports are added here (Figure S1, S2, S3). For each support, the samples were tested up to 300^{0}C and the stability of the existing acidic sites were observed. It is evident that as the temperature goes up from 25^{0}C to 300^{0}C, the acid sites lose their stability. When Aluminum bromide is added to the support, the stability of the newly added acid sites from Aluminum bromide was firm even at temperature as high as 300^{0}C (see main manuscript).

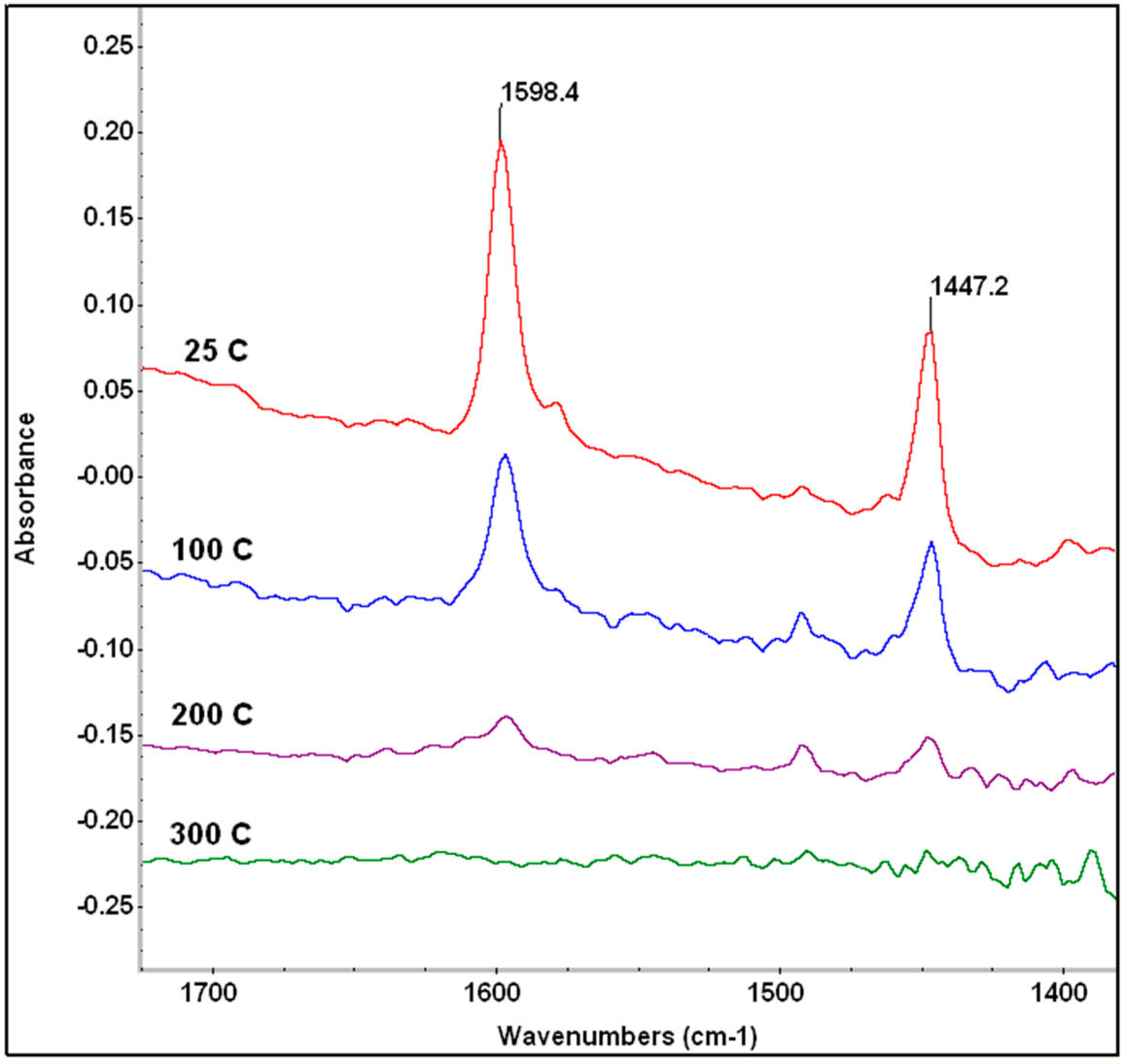

Figure S1. DRIFTS spectra for MCM-41 after pyridine treatment at various temperatures.

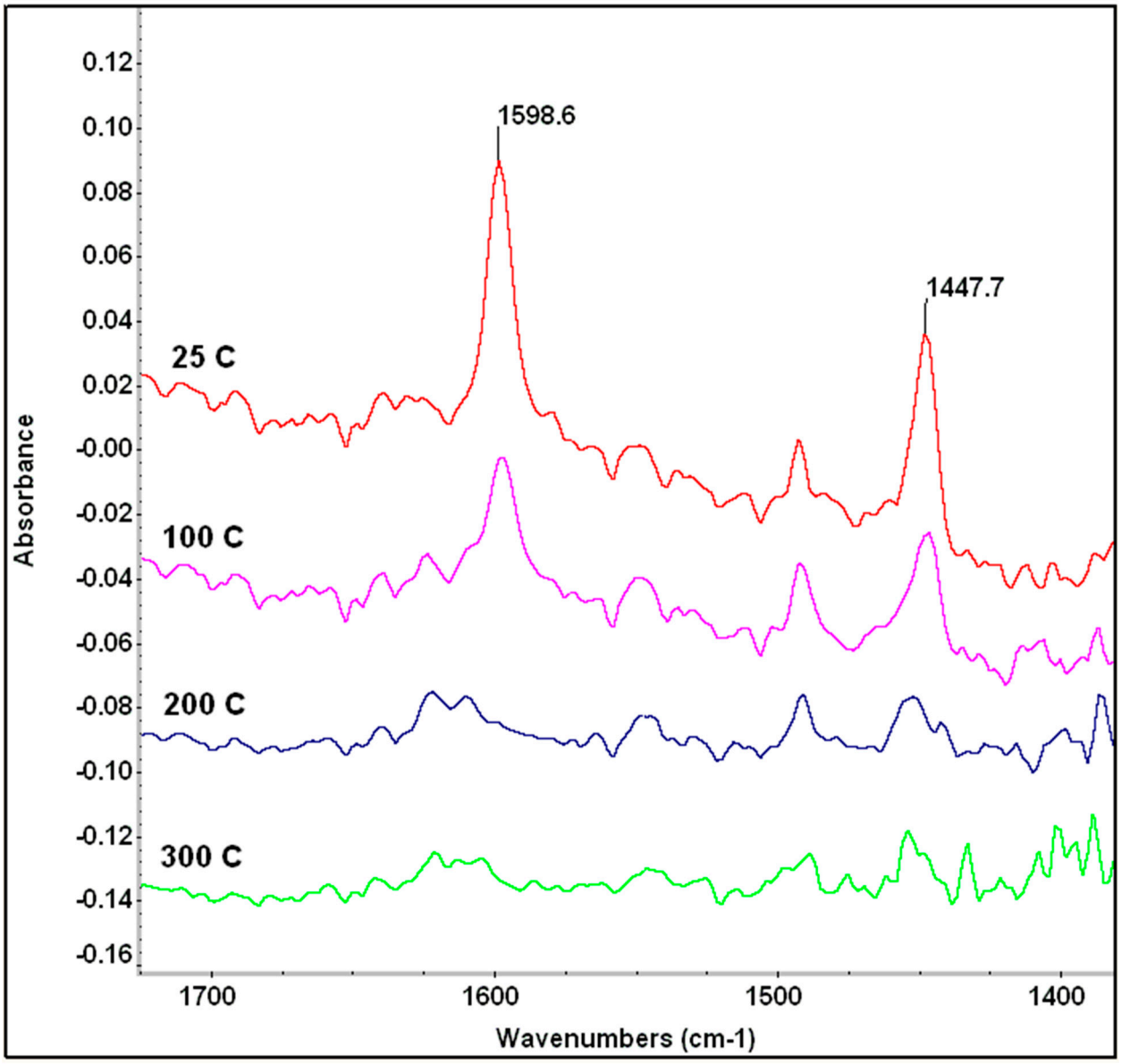

Figure S2. DRIFTS spectra for SBA-15 after pyridine desorption at various temperatures.

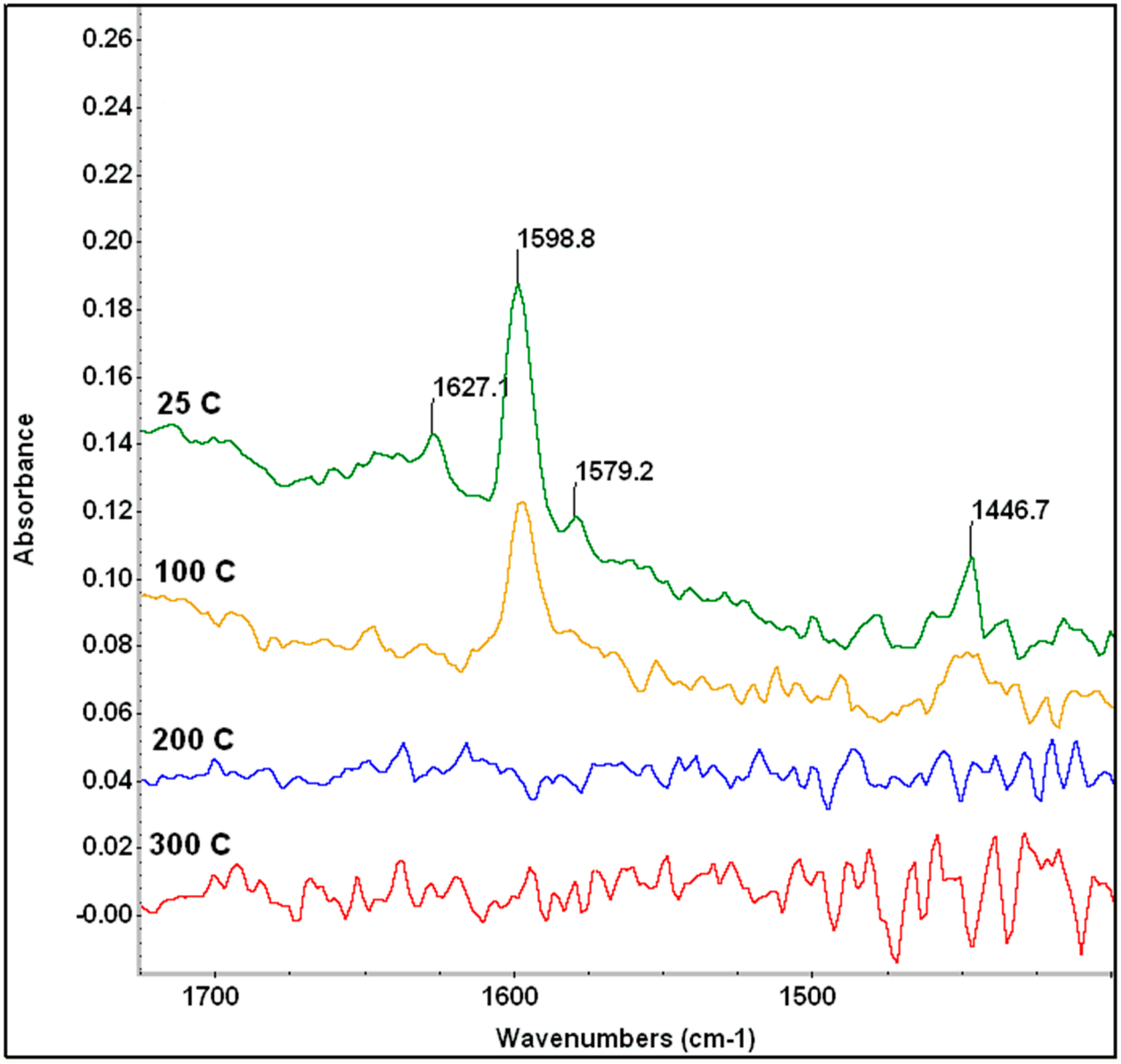

Figure S3. DRIFTS spectra for Silica gel after treatment at various temperatures.

2. Deconvoluted MS peaks for prepared catalysts from NH_3-TPD

For the base MCM-41, almost no acidity was observed except for a very small peak around 140 ^{o}C that corresponds to the weak acid sites (most likely due to hydroxyl groups). For ABM4 catalyst (Figure S4), TCD peaks at around 155°C, 197°C could be observed upon deconvolution. The first peak observed corresponds to weak acid site: mainly hydroxyl groups and the peak at around 200^{o}C can be attributed to moderate acid sites. For peak temperatures above 300°C, insignificant ammonia desorption could be observed from MS signals, indicating the absence of very strong acid sites.

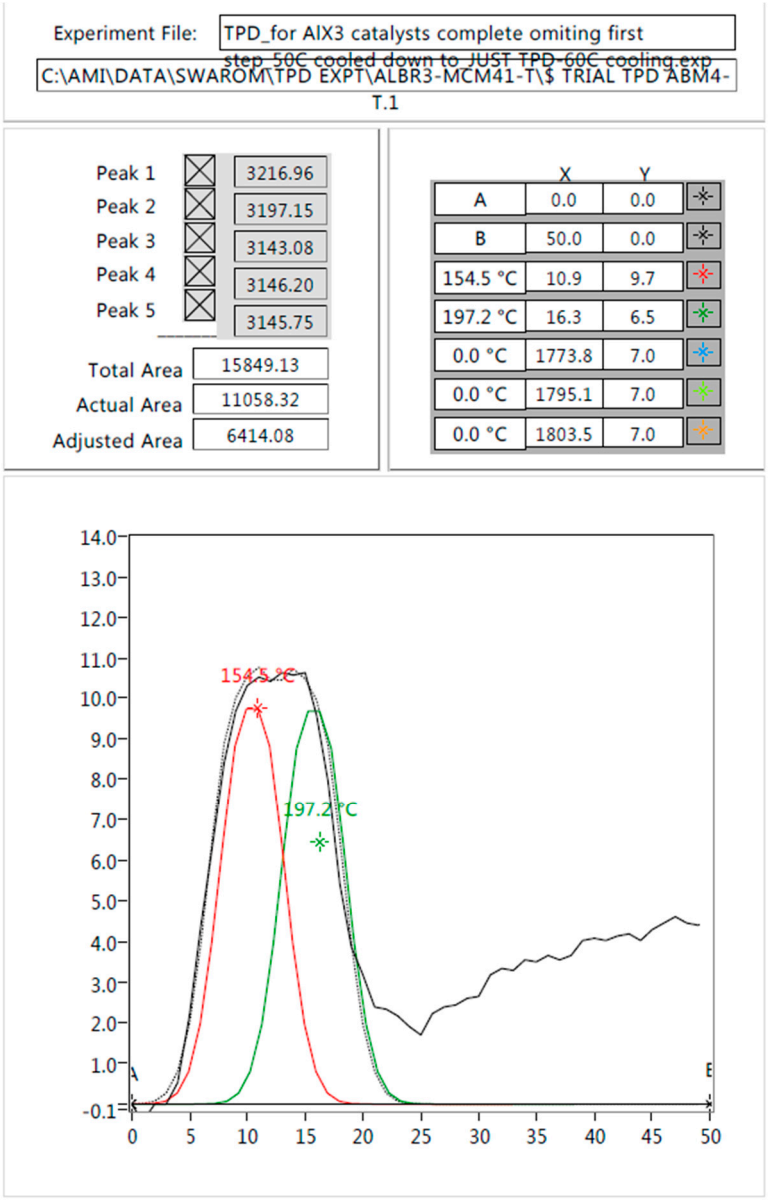

Figure S4. Deconvoluted MS peaks for ABM4 catalyst.

TPD for ammonia desorption for ABSB catalyst could be seen in Fig. 13. Two peaks could be deconvoluted for this catalyst (Figure S5). It is similar to TPD profile for ABM4, with the two peaks at 143 °C, and 195 °C.

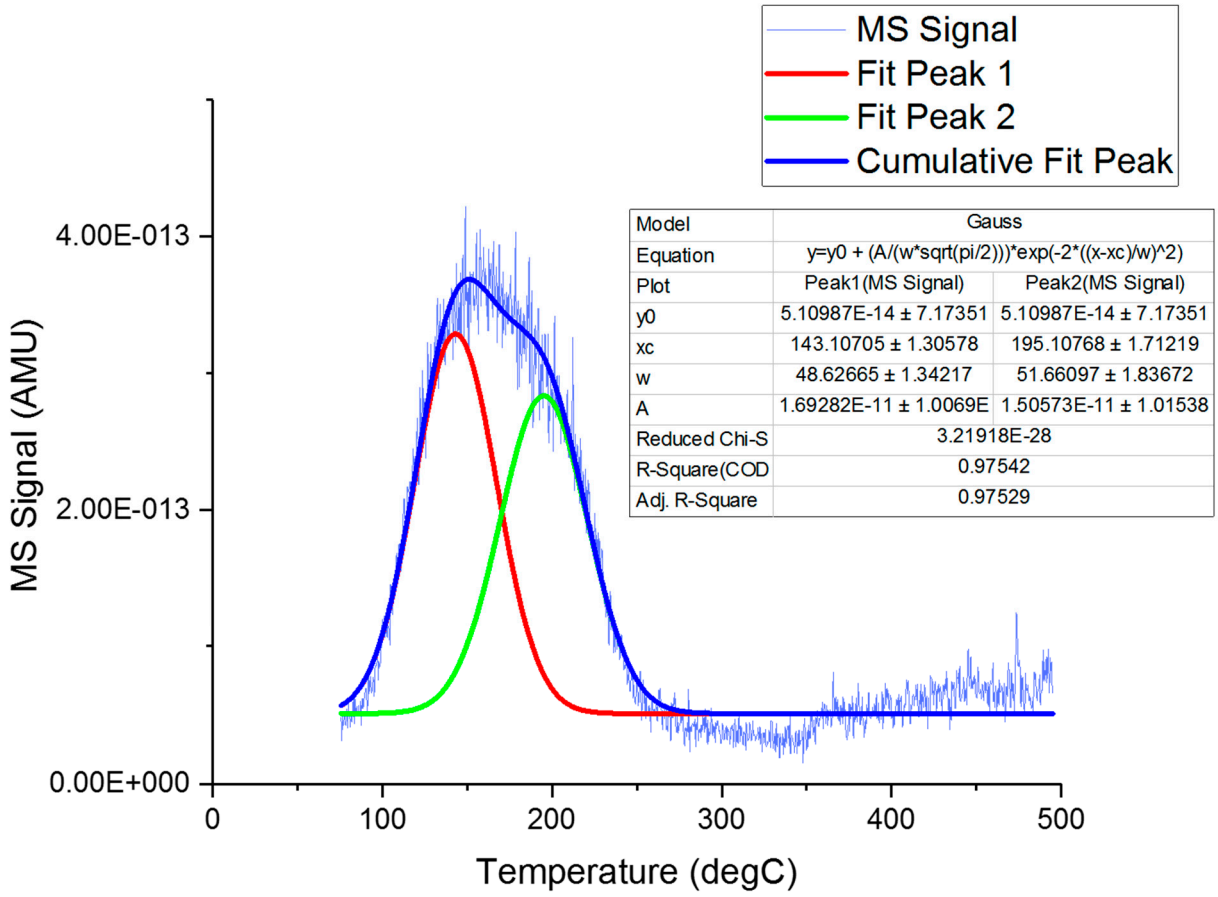

Figure S5. Deconvoluted MS peaks for ABSB catalyst.

The peaks of ABSi catalyst at 144°C and 179°C correspond to weak-to-medium strength acid sites (Figure S6). These could be attributed to weak surface hydroxyl groups. This is clearly in contrast with the results from DRIFTS experiment where moderately strong both types of acid sites (L and B) could be observed.

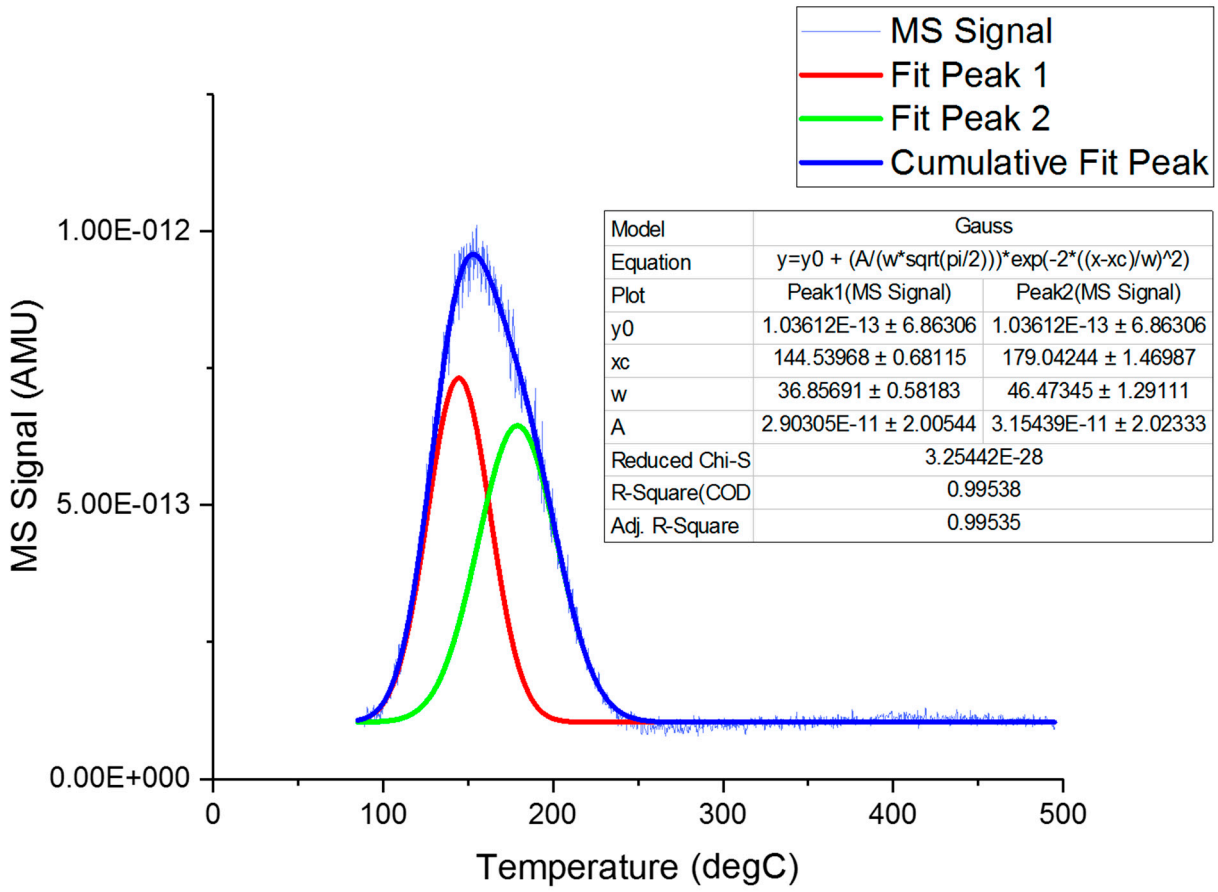

Figure S6. Deconvoluted MS peaks for ABSi catalyst.

3. Isotherm linear plots for silica supports

Figures S7-S9 show the adsorption desorption isotherm linear plots for silica supports. Not much change is observed in the linear plots for adsorption and desorption. A Hysteresis loop is observed at higher relative pressure (P/P_0) both for Silica gel and MCM-15, whereas it was observed at halfway point for SBA-15 support.

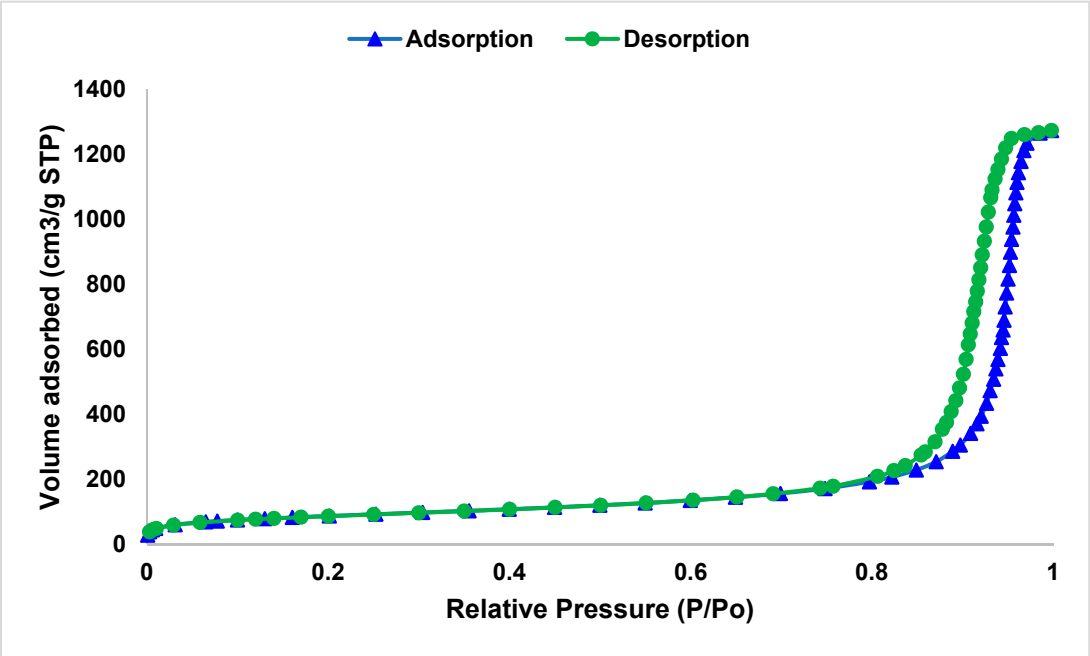

Figure S7. Isotherm linear plot for Silica Gel.

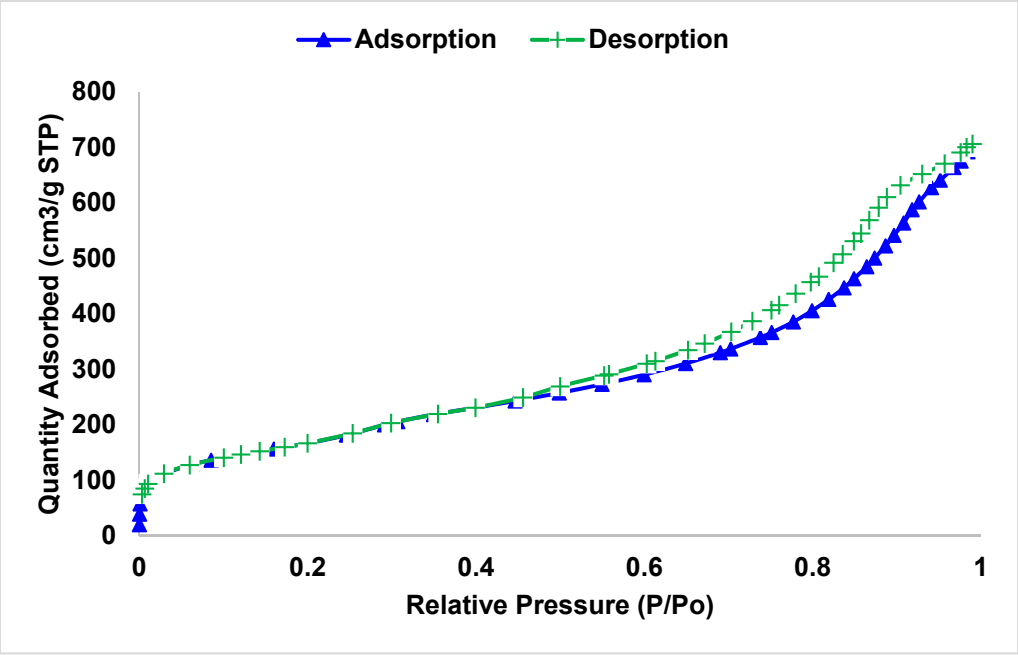

Figure S8. Isotherm linear plot for MCM-41.

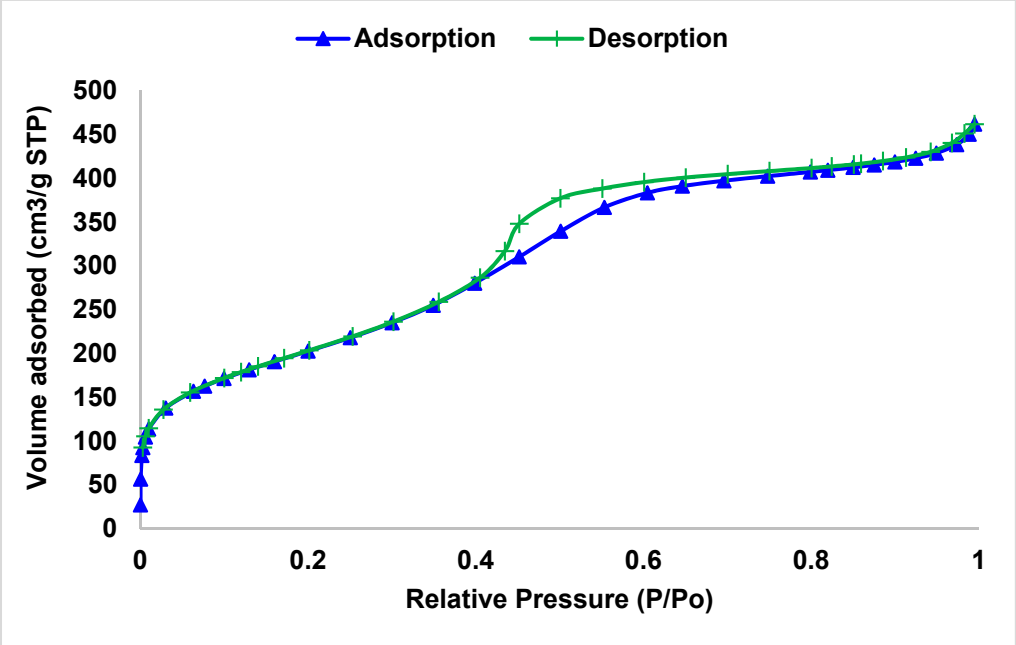

Figure S9. Isotherm linear plot for SBA-15.

3. Pore Size Distribution data from Vendors

3.1. MCM-41 (Bonding Chemicals)

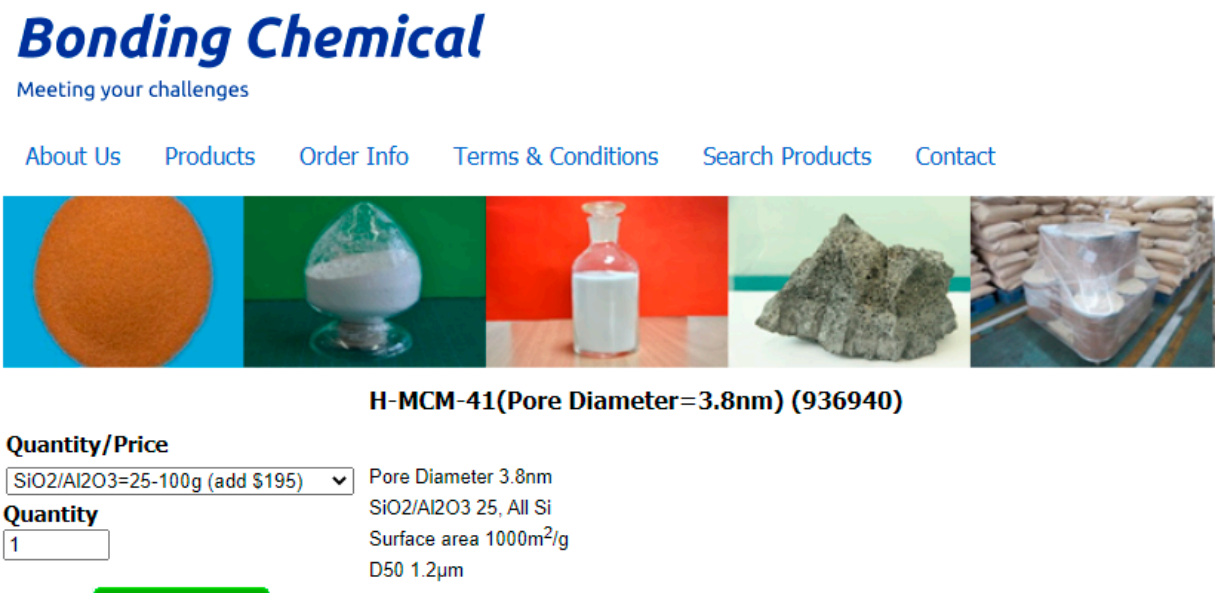

Figure S10. Confirmation of pore diameter for MCM-41 from manufacturer website.

3.2. SBA-15 (Bonding Chemicals)

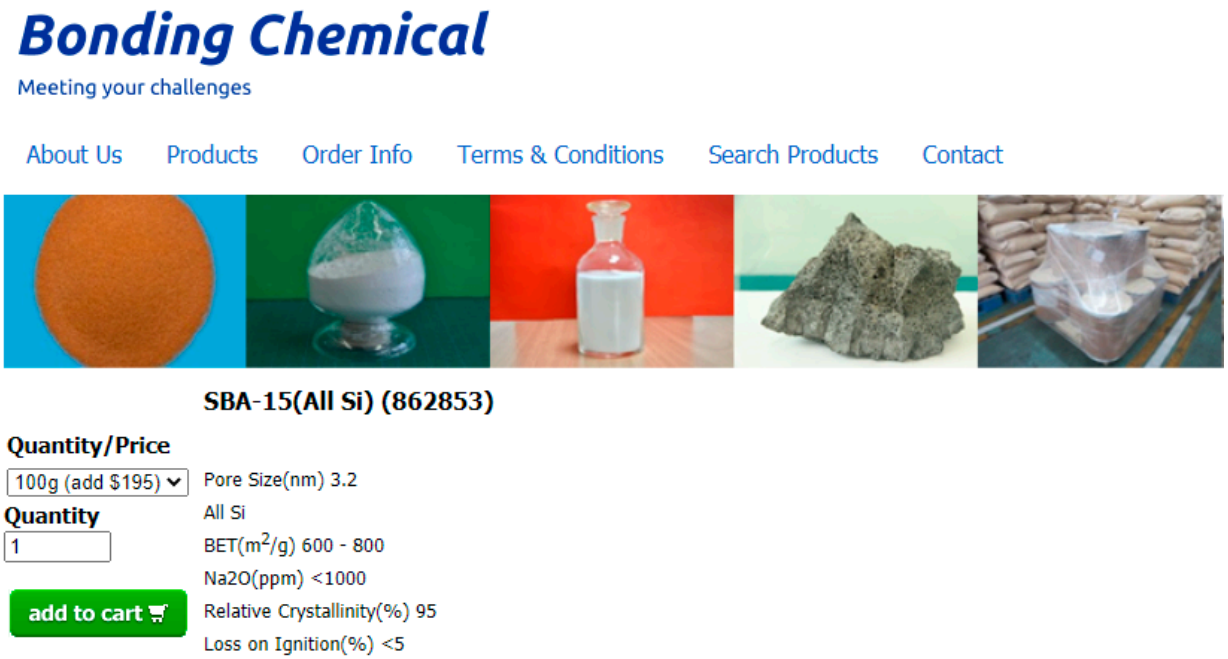

Figure S11. Confirmation of pore diameter for SBA-15 from manufacturer website.