Electronic Supplementary Material (ESI) for Catalysis Science & Technology.

Supporting information

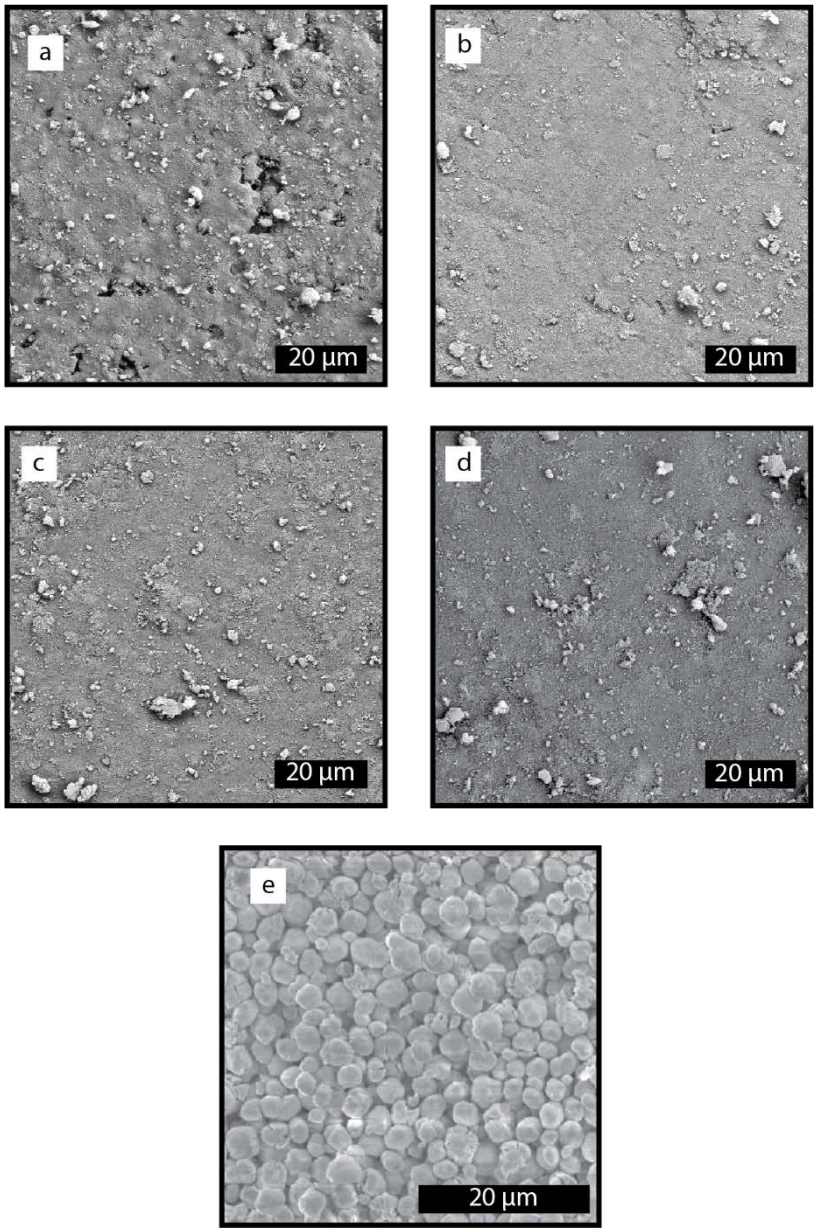

Figure S1. Scanning Electron Microscopy (SEM) image of the surface of (a) 20:80 Al_2O_3, (b) 20:80 SiO_2, (c) Al_2O_3, (d) SiO_2 and (e) ZSM-5.

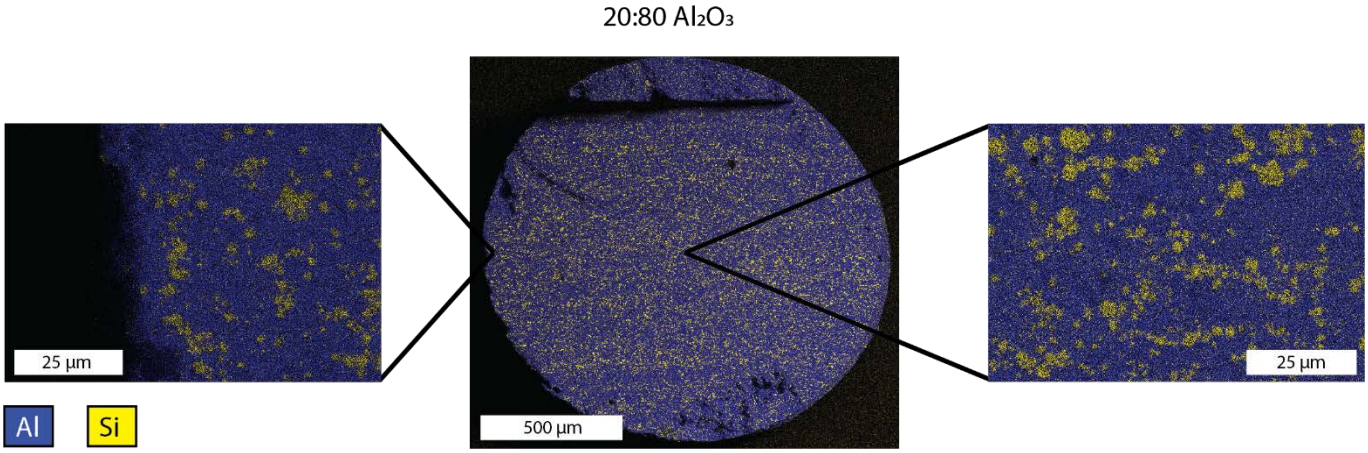

Figure S2. SEM-EDX map of a cross section of 20:80 Al_2O_3 surface. The SEM-EDX map shows that the ZSM-5 crystals are equally distributed throughout the extrudate. In this map, Si is colored yellow and Al is colored blue.

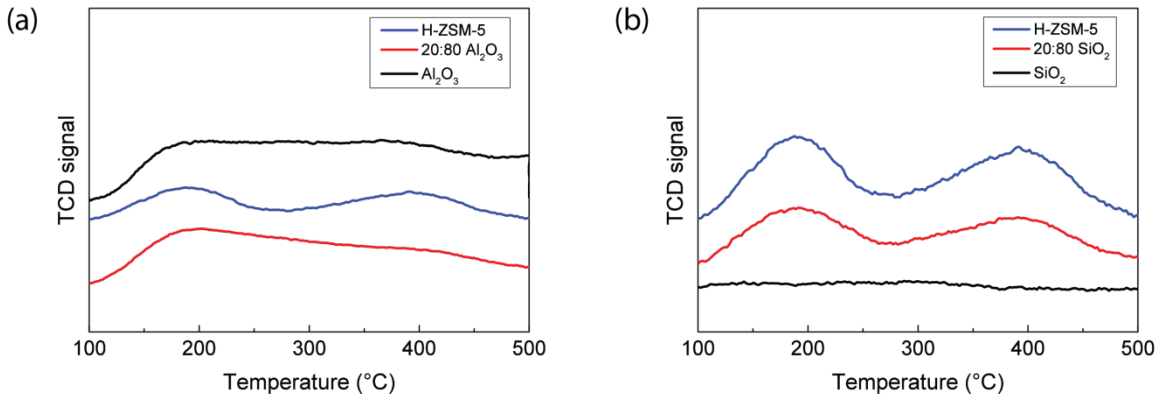

Figure S3. NH_3 TPD profiles of the different samples with (a) Al_2O_3 binder and (b) SiO_2 binder.

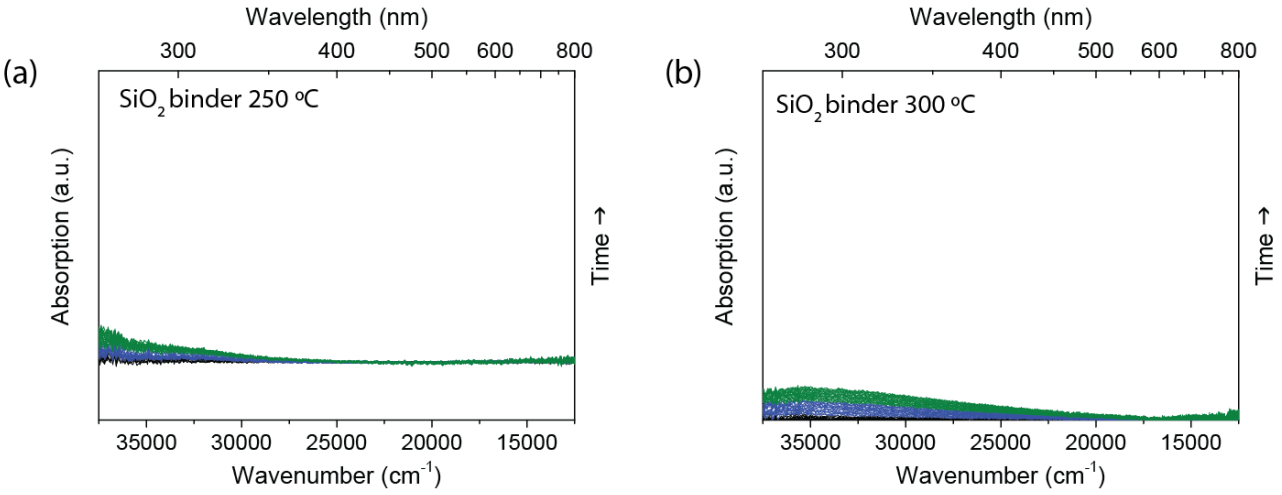

Figure S4. Time-resolved *operando* UV-vis diffuse reflectance spectra during the oligomerization reaction with 1-hexene over SiO_2 binder at (a) 250 °C and (b) 300 °C for 1 h. The black spectra are taken the first 5 min, for the next 25 min the spectra are shown in blue and the last 30 min are green.

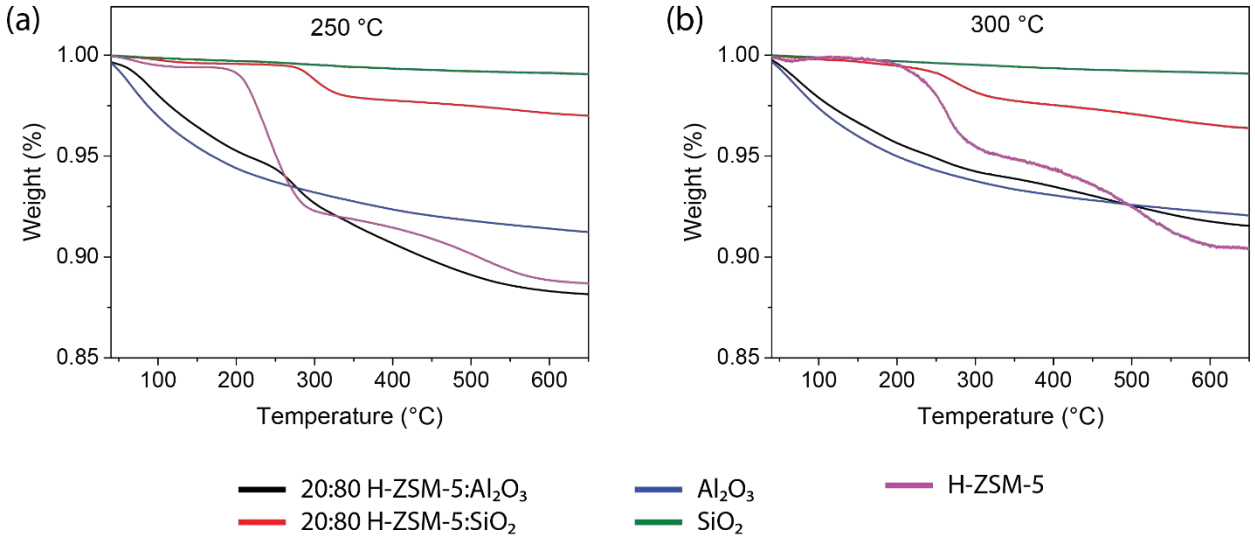

Figure S5. TGA measurements of the different extrudates showing the weight loss for reaction at (a) 250 °C and (b) 300 °C. The weight percent in Table 1 shows the weight loss between 100 °C – 700 °C.

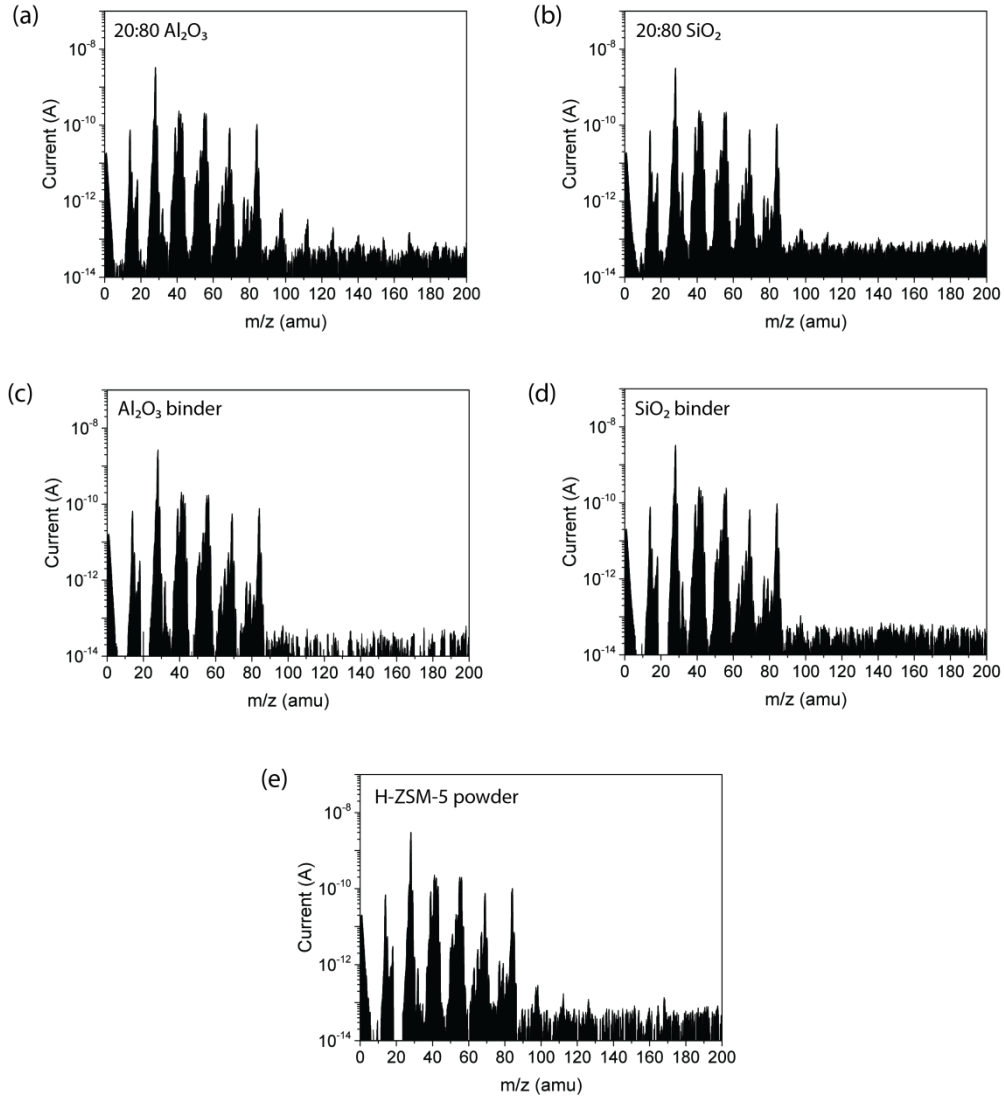

Figure S6. Mass spectra taken after 10 min of 1-hexene oligomerization reaction at 250 °C of (a) 20:80 Al_2O_3, (b) 20:80 SiO_2, (c) Al_2O_3 binder, (d) SiO_2 binder and (e) H-ZSM-5 powder.

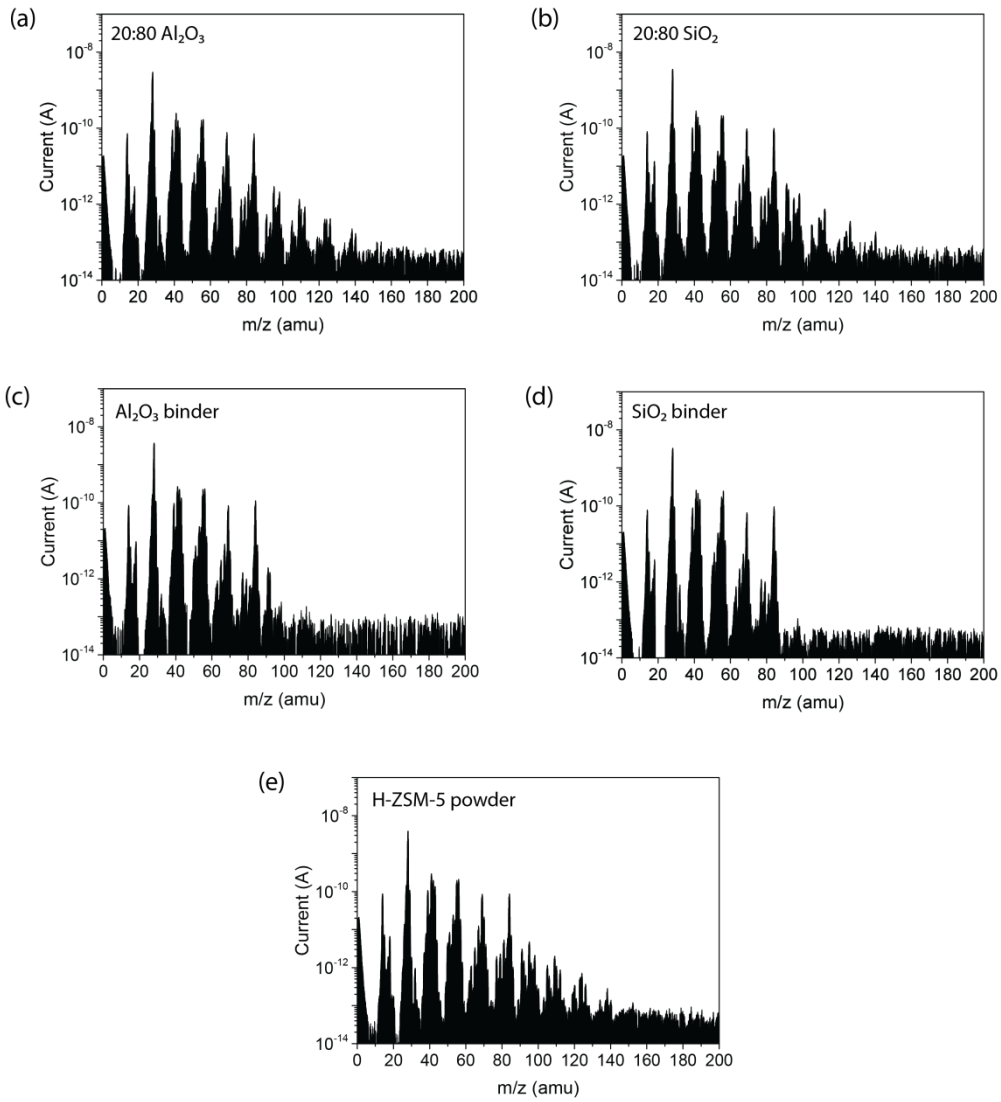

Figure S7. Mass spectra taken after 10 min of 1-hexene oligomerization reaction at 300 °C of (a) 20:80 Al_2O_3, (b) 20:80 SiO_2, (c) Al_2O_3 binder, (d) SiO_2 binder and (e) H-ZSM-5 powder.

Video S1. *In-situ* 2-D confocal fluorescence microscopy movies taken during 1 h of 1-hexene oligomerization at 300 °C of 20:80 SiO2. Excitation with 404 nm, 488 nm, 562 nm and 642 nm laser causes respectively the blue, green and red (both 562 and 642 nm laser) fluorescence.

Video S2. *In-situ* 2-D confocal fluorescence microscopy movies taken during 1 h of 1-hexene oligomerization at 300 °C of 20:80 Al2O3. Excitation with 404 nm, 488 nm, 562 nm and 642 nm laser causes respectively the blue, green and red (both 562 and 642 nm laser) fluorescence.