

## Supplementary Materials

# Lipid-Inorganic Hybrid Particles with non-Lamellar Structures

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## Methods

### *Nuclear Magnetic Resonance (NMR)*

$^1\text{H}$  (300.22 MHz),  $^{13}\text{C}$  (75.50 MHz) and  $^{29}\text{Si}$ -DEPT (69.63 MHz) NMR-Spectra were measured by a Mercury 300 MHz Spectrometer from Varian at 25 °C. The chemical shifts are given in parts per million (ppm), related to tetramethylsilane (TMS) ( $\delta = 0$  ppm).  $^{29}\text{Si}$ -DEPT-NMR-spectroscopy was done with  $^2J$ -coupling constant of 6.5 Hz and multiplicity of 0.5.

### *Fourier Transform Infrared Spectroscopy*

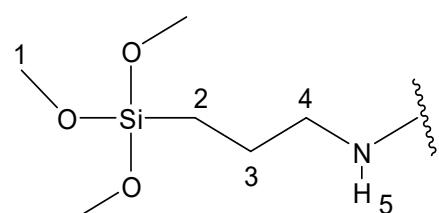
The Fourier transform infrared spectroscopy (FT-IR) analyses were performed using an ALPHA spectrometer from Bruker (Bruker Optik GmbH, Ettlingen, Germany). The FT-IR spectra were recorded from 4000  $\text{cm}^{-1}$  to 500  $\text{cm}^{-1}$ .

## Results

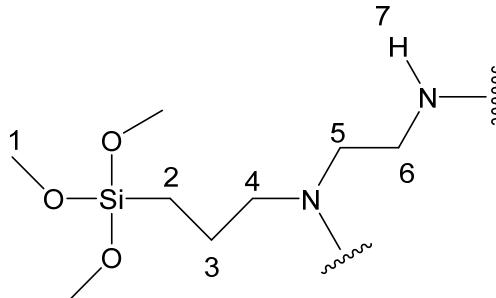
### *NMR*

Numbering of the chemical shift to the corresponding atoms:

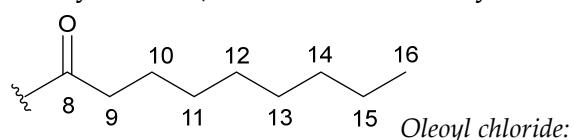
Silane with one oleoyl chain:



Silane with two oleoyl chains:

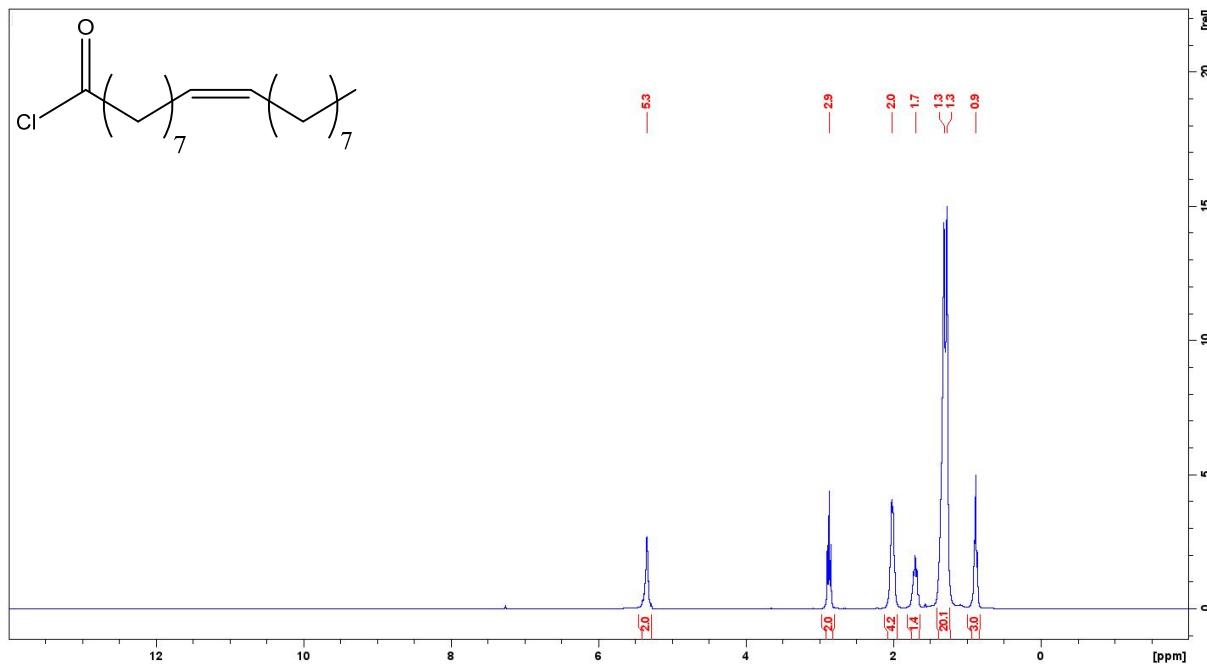


Oleoyl chain (atoms consecutively numbered):

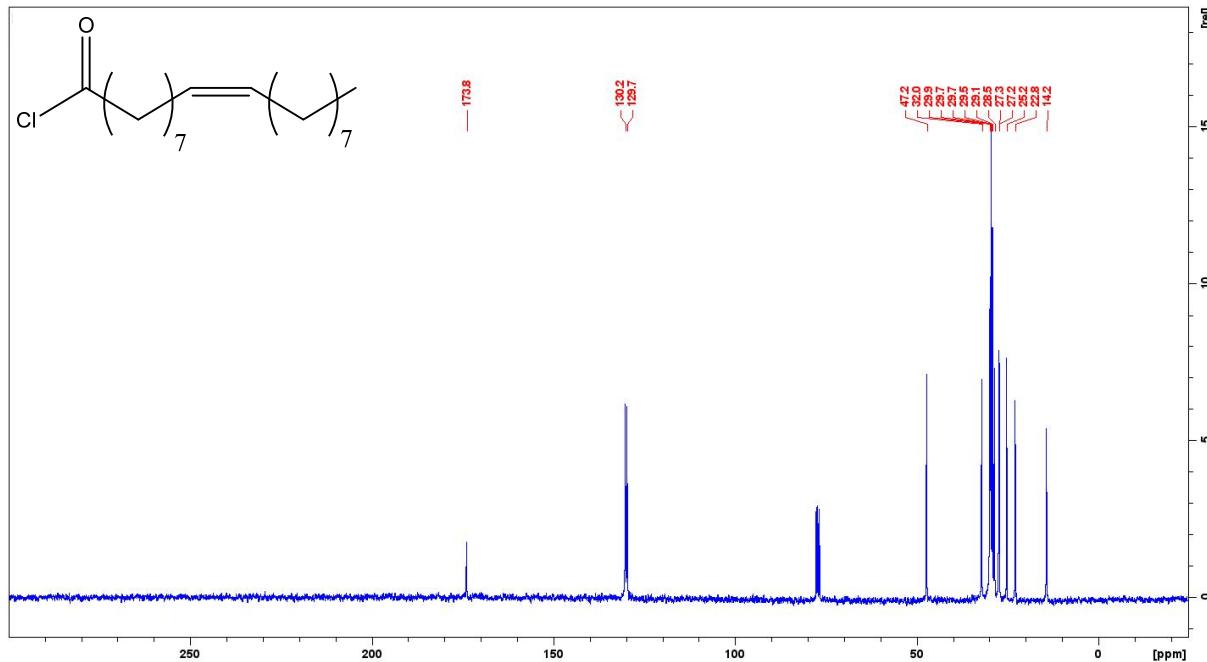


$^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$ : 5.3 (m, 2H, 16 & 17); 2.9 (t, 2H, 9); 2.0 (q, 4H, 15 & 18); 1.7 (p, 2H, 10); 1.31-1.27 (m, 20H, 11-14 & 19-24); 0.9 (t, 3H, 25) ppm.

$^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 75.5 MHz)  $\delta$ : 173.8 (1C, 8); 130.2 (1C, 16); 129.7 (1C, 17); 47.2 (1C, 9); 32.0 (1C, 23); 29.9 -28.5 (8C, 11-14, 19-22); 27.3 (1C, 18); 27.2 (1C, 15); 25.2 (1C, 10); 22.8 (1C, 24); 14.2 (1C, 25) ppm.



**Figure S1.**  $^1\text{H}$ -NMR Spectra of the distilled oleoyl chloride in  $\text{CDCl}_3$ .



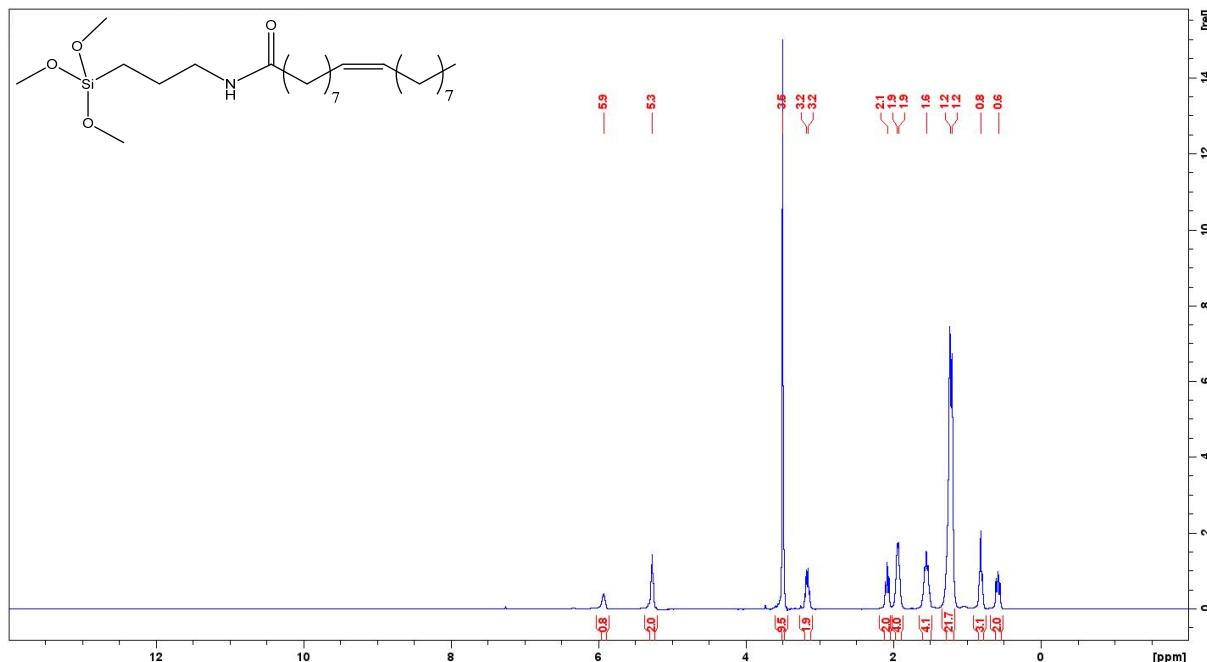
**Figure S2.**  $^{13}\text{C}$ -NMR Spectra of the distilled oleoyl chloride in  $\text{CDCl}_3$ .

*Precursor A: N-[3-(trimethoxysilyl)propyl]oleamide*

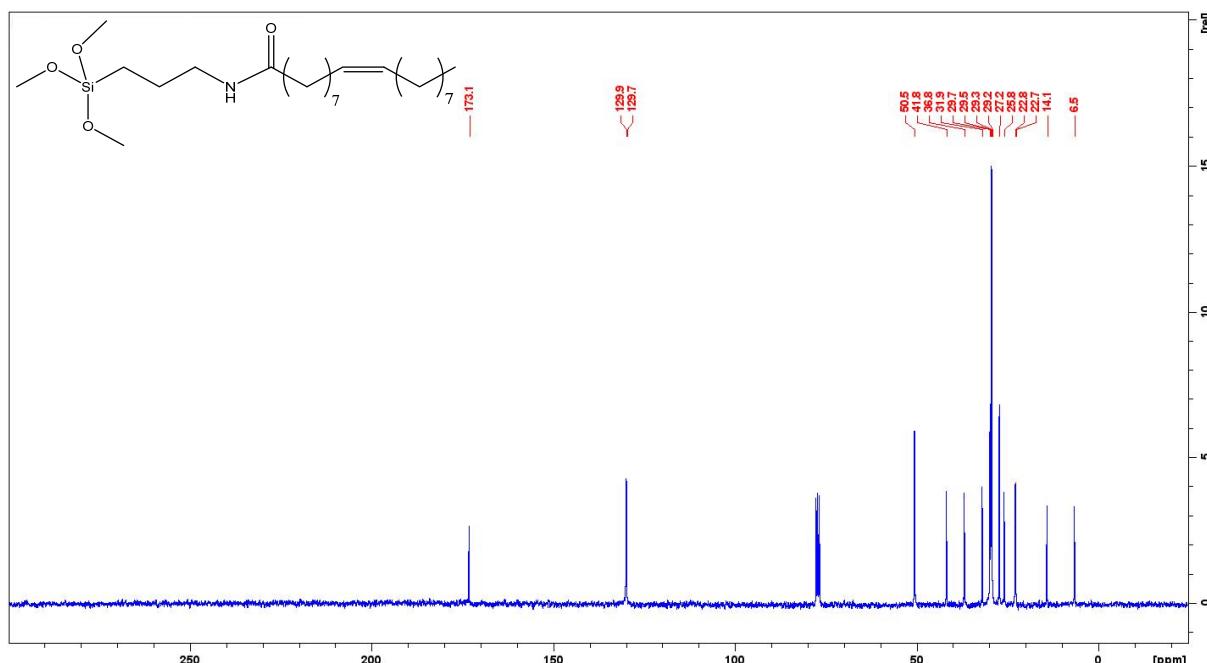
$^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$ : 5.9 (t, 1H, 5); 5.3 (m, 2H, 16 & 17); 3.5 (s, 9H, 1); 3.2 (q, 2H, 4); 2.1 (t, 2H, 9); 1.9 (q, 4H, 15 & 18); 1.6 (p, 4H, 3 & 10); 1.24-1.20 (20H, 11-14, 19-24); 0.8 (t, 3H, 25); 0.6 (t, 2H, 2) ppm.

$^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 75.5 MHz)  $\delta$ : 173.1 (1C, 8); 129.9 (1C, 16); 129.7 (1C, 17); 50.5 (3C, 1); 41.8 (1C, 4); 36.8 (1C, 9); 31.9 (1C, 23); 29.7-29.2 (8C, 11-14, 19-22); 27.2 (2C, 15 & 18); 25.8 (1C, 10); 22.8 (1C, 3); 22.7 (1C, 24); 14.1 (1C, 25); 6.5 (1C, 2) ppm.

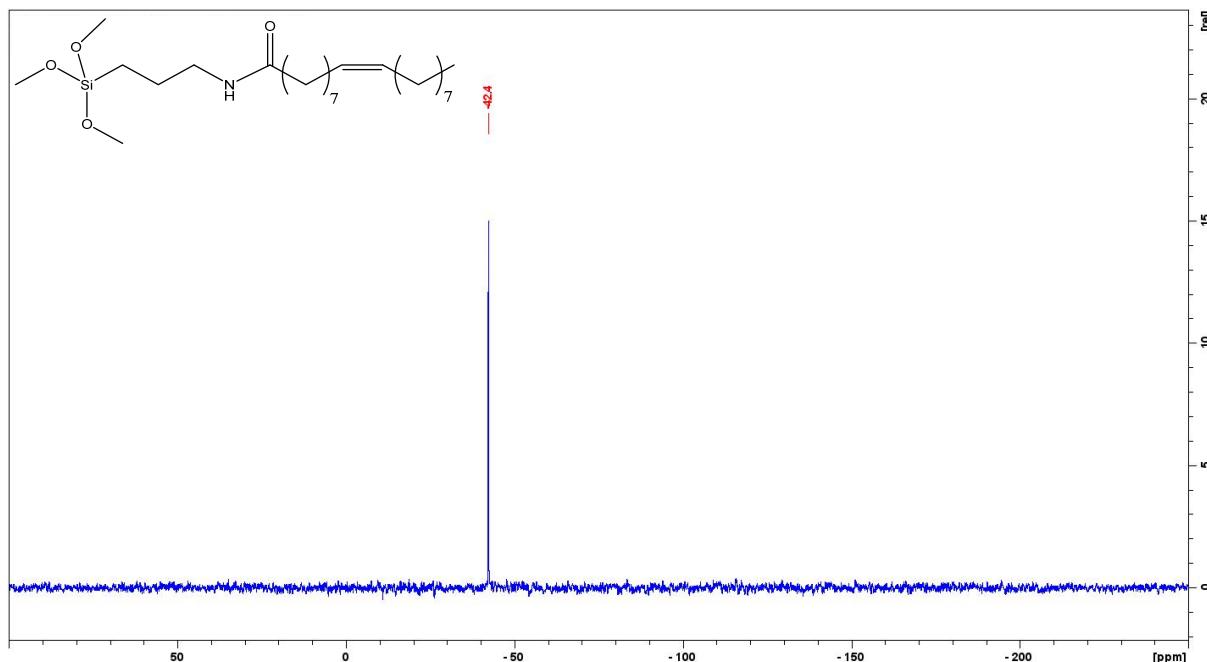
$^{29}\text{Si}$  NMR ( $\text{CDCl}_3$ , 69.63 MHz)  $\delta$ : -42.4 ppm.



**Figure S3.**  $^1\text{H}$ -NMR Spectra of N-[3-(trimethoxysilyl)propyl]oleamide in  $\text{CDCl}_3$ .



**Figure S4.**  $^{13}\text{C}$ -NMR Spectra of N-[3-(trimethoxysilyl)propyl]oleamide in  $\text{CDCl}_3$ .



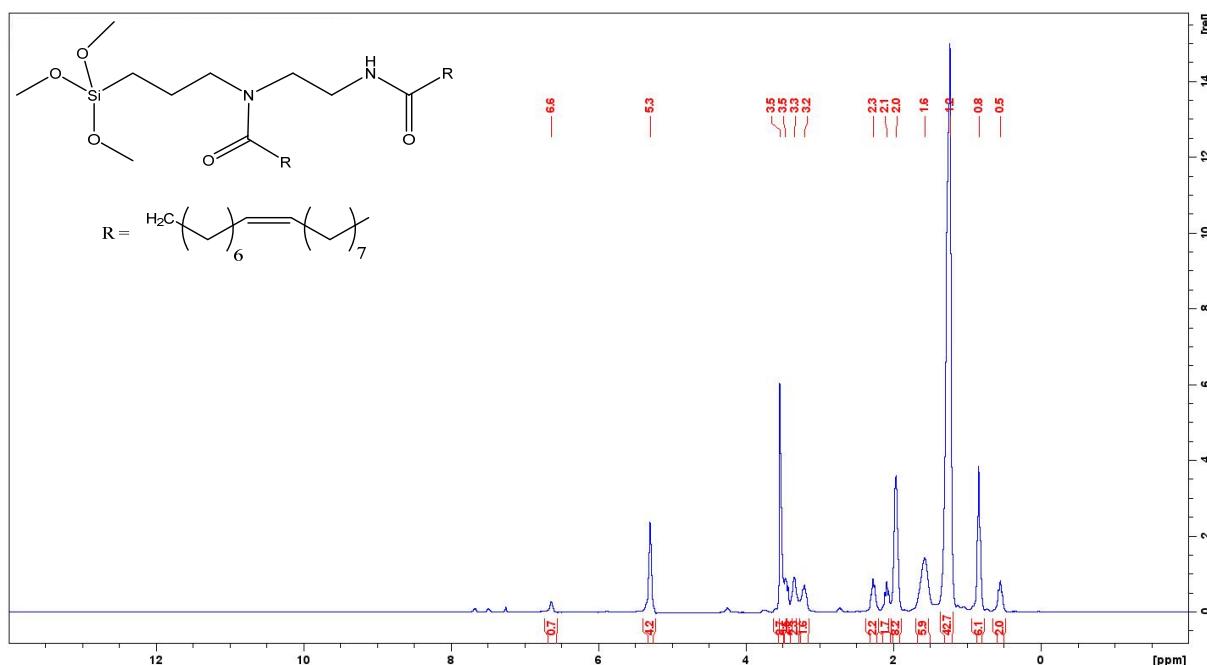
**Figure S5.**  $^{29}\text{Si}$ -DEPT-NMR Spectra of N-[3-(trimethoxysilyl)propyl]oleamide in  $\text{CDCl}_3$ .

Precursor B: N-[2-(Oleoylamino)ethyl]-N-[3-(trimethoxysilyl)propyl]oleamide:

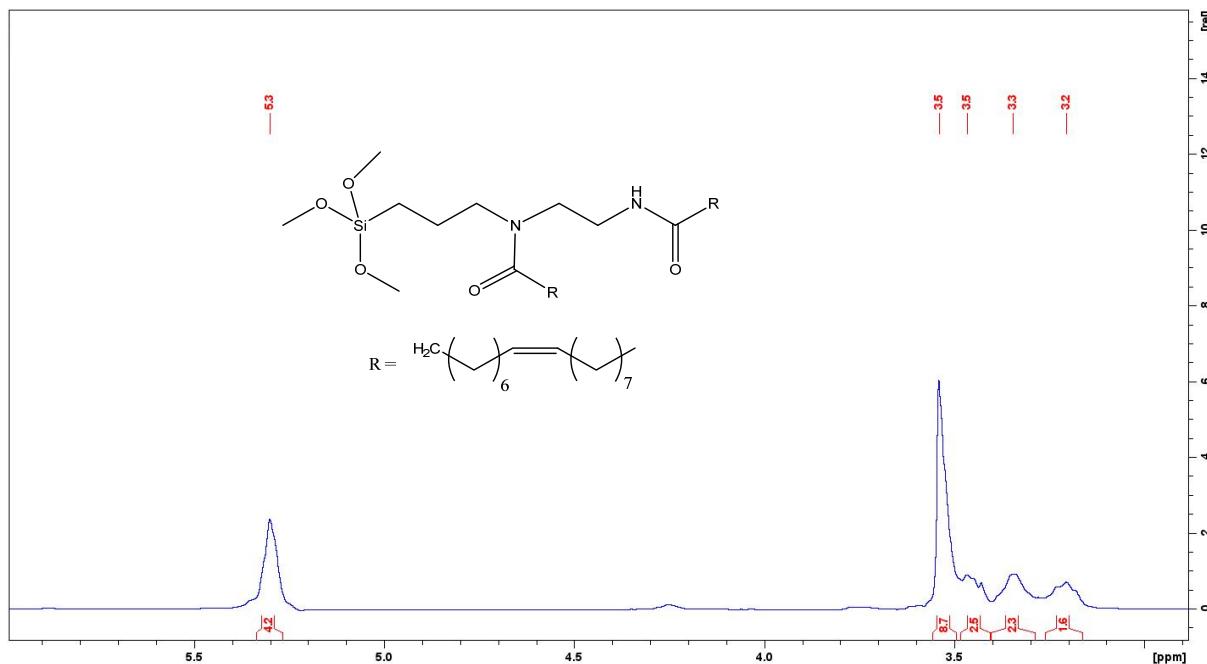
$^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz)  $\delta$ : 6.6 (m, 1H, 7); 5.3 (m, 4H, 16, 17, 34, 35); 3.5 (s, 9H, 1); 3.5 (m, 2H, 6); 3.3 (t, 2H, 5); 3.2 (m, 2H, 4); 2.3 (t, 2H, 9); 2.1 (t, 2H, 27); 2.0 (m, 8H, 15, 18, 33, 36); 1.6 (m, 6H, 3, 10, 28); 1.24-1.20 (42H, 11-14, 19-24, 29-32, 37-42); 0.8 (t, 6H, 25 & 43); 0.5 (t, 2H, 2) ppm.

$^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 75.5 MHz)  $\delta$ : 174.9 (1C, 8); 173.6 (1C, 26); 129.9 (2C, 16 & 34); 129.7 (2C, 17 & 35); 50.6 (3C, 1); 44.7 (1C, 4); 39.6 (1C, 6); 36.7 (1C, 9); 33.0 (1C, 27); 31.9 (2C, 23 & 41); 29.7-29.3 (16C, 11-14, 19-22, 29-32, 37-40); 27.2 (4C, 15, 18, 33, 36); 25.7 (1C, 28); 25.5 (1C, 10); 22.6 (2C, 24 & 42); 22.2 (1C, 3); 14.1 (2C, 25 & 43); 6.1 (1C, 2) ppm.

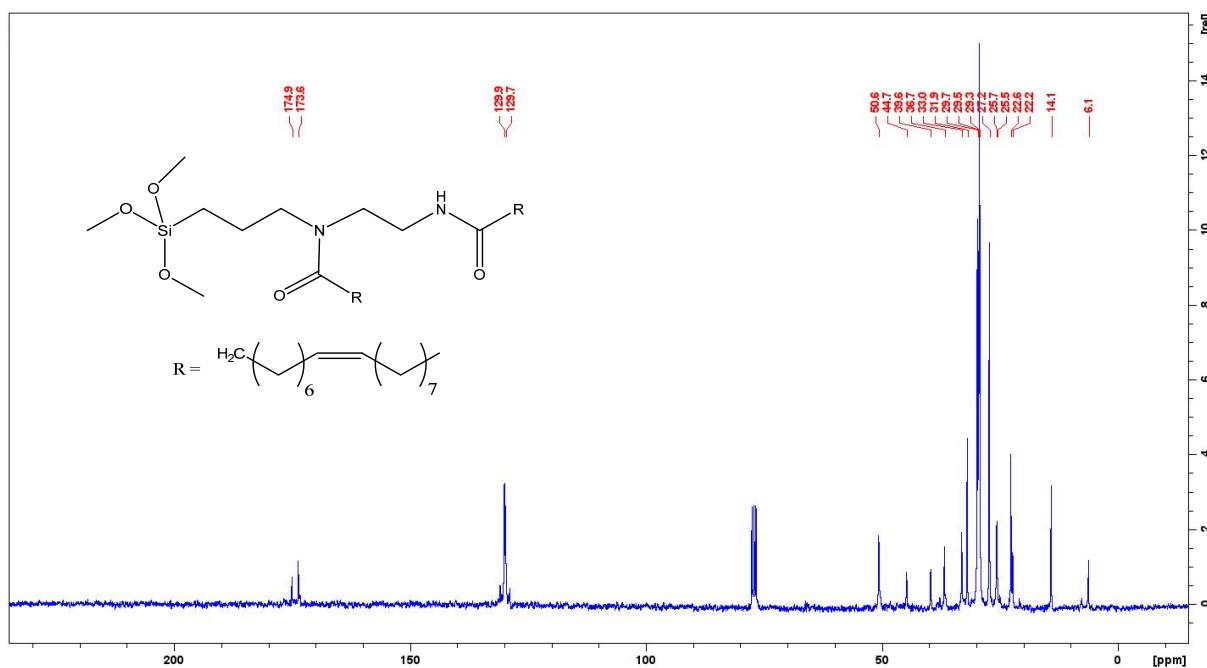
$^2\text{Si}$  NMR ( $\text{CDCl}_3$ , 69.63 MHz)  $\delta$ : -43.4 ppm.



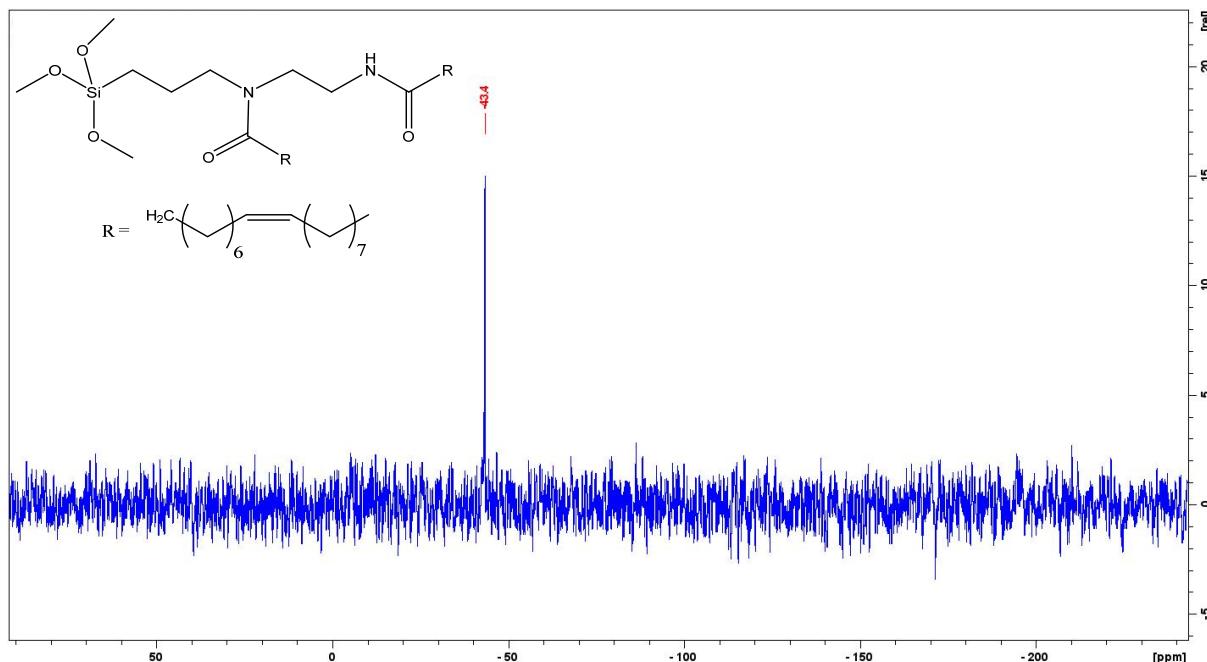
**Figure S6.**  $^1\text{H}$ -NMR Spectra of the N-[2-(oleoylamino)ethyl]-N-[3-(trimethoxysilyl)propyl]oleamide in  $\text{CDCl}_3$ .



**Figure S7.**  $^1\text{H}$ -NMR Spectra (from 5.5 to 3.0 ppm) of the N-[2-(oleoylamino)ethyl]-N-[3-(trimethoxysilyl)propyl]oleamide in  $\text{CDCl}_3$ .



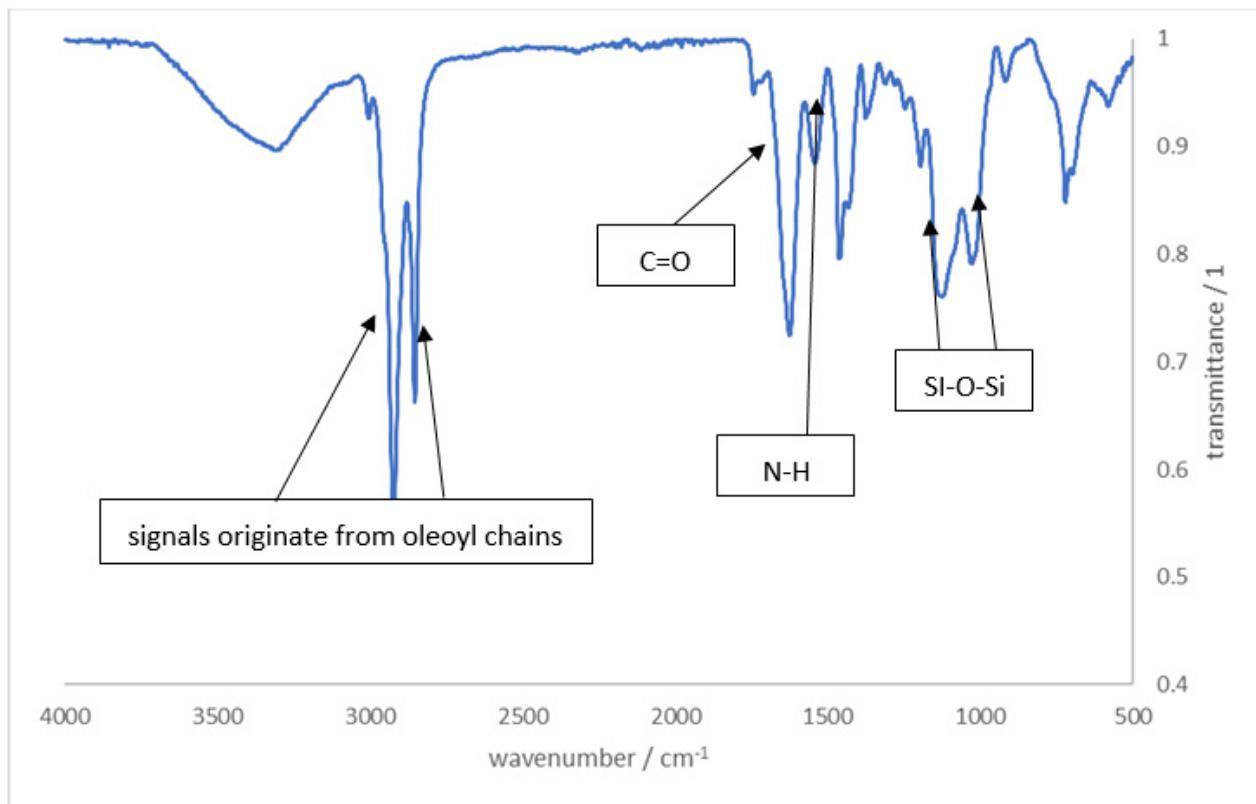
**Figure S8.**  $^{13}\text{C}$ -NMR Spectra of N-[2-(oleoylamino)ethyl]-N-[3-(trimethoxysilyl)propyl]oleamide in  $\text{CDCl}_3$ .



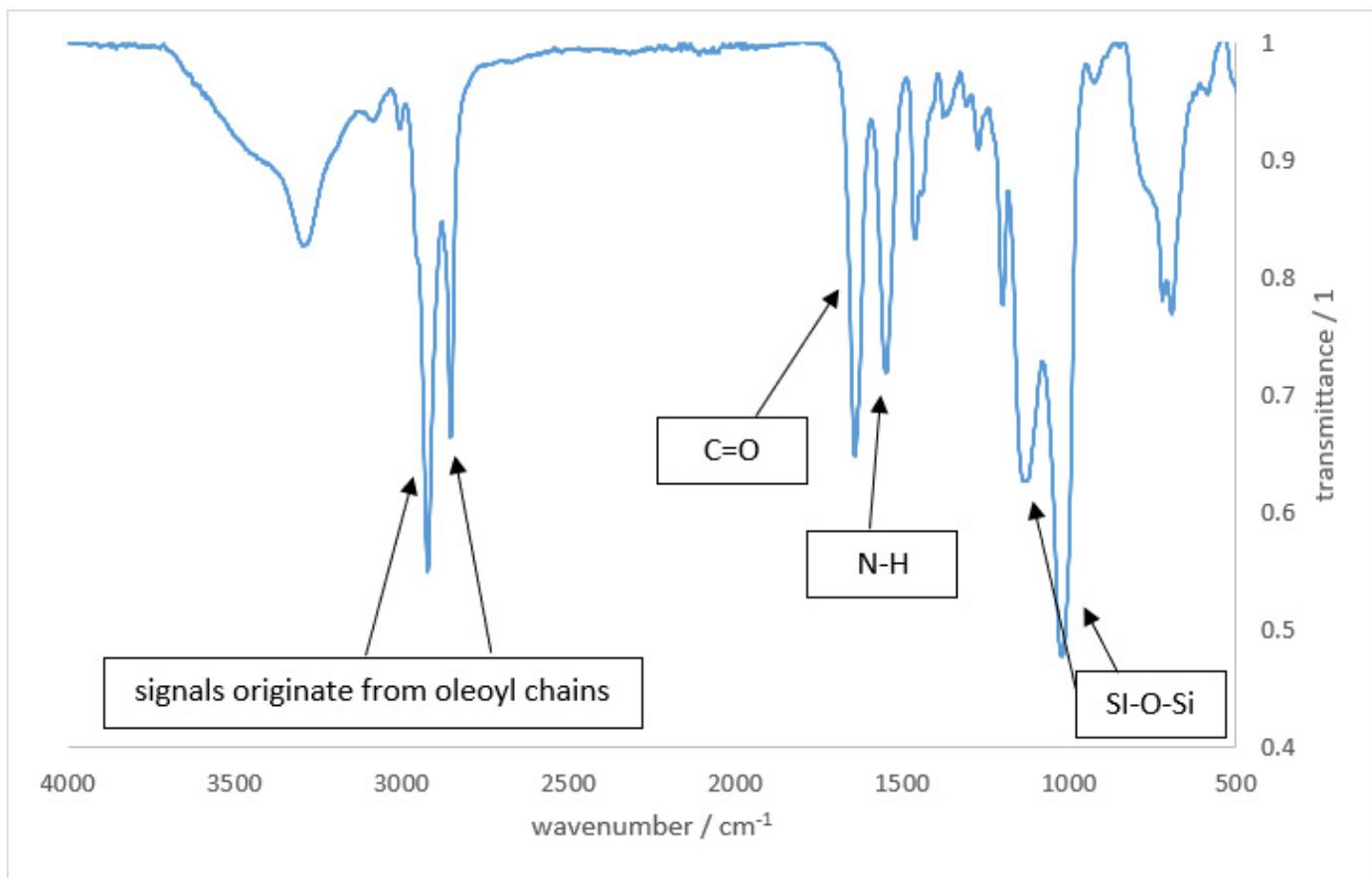
**Figure S9.**  $^{29}\text{Si}$ -DEPT-NMR Spectra of  $N\text{-}[2\text{-}(oleylamino)\text{ethyl}]\text{-}N\text{-}[3\text{-}(trimethoxysilyl)\text{propyl}]oleamide$  in  $\text{CDCl}_3$ .

#### FT-IR Spectroscopy

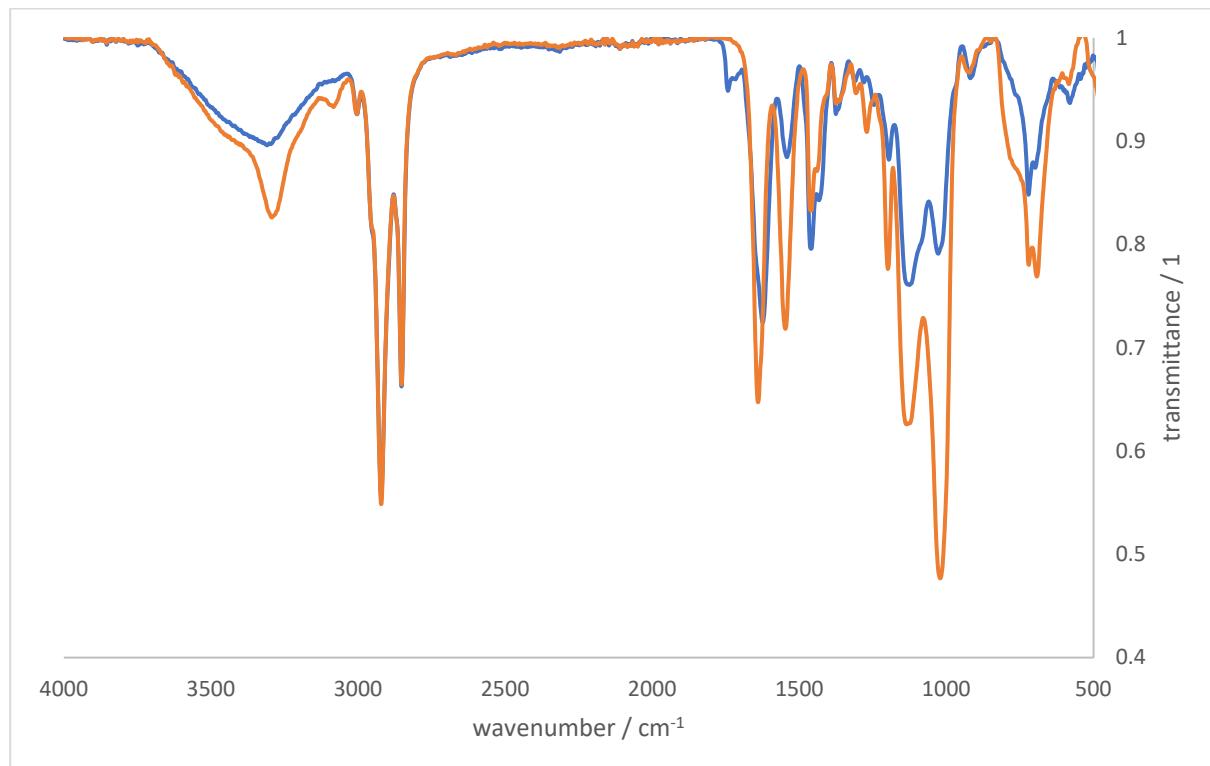
FT-IR-spectroscopy of polymerized  $N\text{-}[3\text{-}(trimethoxysilyl)\text{propyl}]oleamide$  and  $N\text{-}[2\text{-}(Oleylamino)\text{ethyl}]\text{-}N\text{-}[3\text{-}(tri-methoxysilyl)\text{propyl}]oleamide$ :



**Figure S10.** FT-IR-Spectra of polymer derivates from  $N\text{-}[2\text{-}(oleylamino)\text{ethyl}]\text{-}N\text{-}[3\text{-}(trimethoxysilyl)\text{propyl}]oleamide$ .



**Figure S11.** FT-IR-Spectra of polymer derivates from N-[3-(trimethoxysilyl)propyl]oleamide.



**Figure S12.** FT-IR-Spectra comparison of polymer derivates from N-[2-(oleoylamino)ethyl]-N-[3-(trimethoxysilyl)propyl]oleamide (blue) and N-[3-(trimethoxysilyl)propyl]oleamide (orange).

The comparison of both spectra (Error! Reference source not found.) shows a higher intensity of the Si-O-Si signal for the spectra of N-[3-(trimethoxysilyl)propyl]oleamide. Additionally, the bond for N-H is less intensive for N-[2-(oleoylamino)ethyl]-N-[3-(trimethoxysilyl)propyl]oleamide in Error! Reference source not found., which belongs to the lower ratio N-H to carbonyl groups which derivates from one primary amide and the presence of one secondary amide.