Experimental Section

Materials

Shellac wax, SSB® Cera 2 (Acid value: 2-25 mgKOH/g and Saponification value: 40-60 mgKOH/g) was received as a generous gift sample from SSB Stroever GmbH & Co. KG., Germany. Rapeseed oil was received as a gift sample from Vandemoortele Lipids N.V., Belgium. Nile red was purchased from Sigma Aldrich Inc., USA. Water purified by the MilliQ system was used for all the experiments.

Preparation of liquid oil-based soft matter system

Accurately weighed samples of shellac were dispersed in rapeseed oil to achieve a concentration range of 0 - 6 % wt. The dispersions were heated at 90 °C under a mild agitation (200 rpm) using magnetic stirrer (Model EM3300T, Labotech Inc, Germany). The clear oily dispersions were then cooled to room temperature resulting in the formation of oleogels.

Water-in-oil emulsions were prepared by first mixing the heated oleogel samples and water at 90 °C under continuous stirring (1000 rpm) using a magnetic stirrer followed by cooling the mixture to room temperature.

Microstructure studies

The microstructure of oleogels was studied using Leitz diaplan microscope (Lietz Wetzlar Germany) equipped with a thermo-electric stage (PE94, Linkam Scientific Instruments Ltd., UK). In all the cases, the imaging was carried out by first melting the oleogels at 90 °C followed by cooling at controlled rate. The real time analysis of crystallization done by capturing images under optical and polarized light at predetermined temperatures over a certain duration.

For confocal microscopy, Nile red was first dissolved in rapeseed oil and this oil was then used for preparing the oleogel and emulsion samples. Samples were imaged using a Nikon A1R confocal microscope (Nikon Instruments Inc., USA). Excitation was performed by means of a 488nm Ar laser and fluorescence was detected through a 525/50 bandpass filter. Images were acquired and processed with Nikon NIS Elements software.

Thermal analysis

The thermal parameters were studied using a Q1000 Differential scanning calorimeter (TA Instruments, USA) on samples weighing 10 mg in flat-bottomed aluminium pans. The samples were subjected to heating and cooling cycles from 5 to 100 °C and back at cooling rates of 1 and 10 °C/min. The thermal parameters were obtained from the heat flow curves with the help of TA Universal Analysis software.

Rheological measurements

The rheological measurements were carried out on advanced rheometer AR 2000ex (TA Insutruments, USA) using a parallel plate geometry of diameter 40mm. The viscoelastic parameters such as storage (G′) and loss (G″) moduli were measured as a function of time at a constant frequency of 0.25 Hz, 0.01 % strain and two different temperatures of 5 and 37 °C; and as a function of angular frequency (ω) from 0.1 to 600 rad/sec at 0.01 % strain and a constant temperature of 25 °C.

Electronic Supplementary Material (ESI) for RSC Advances

Figures

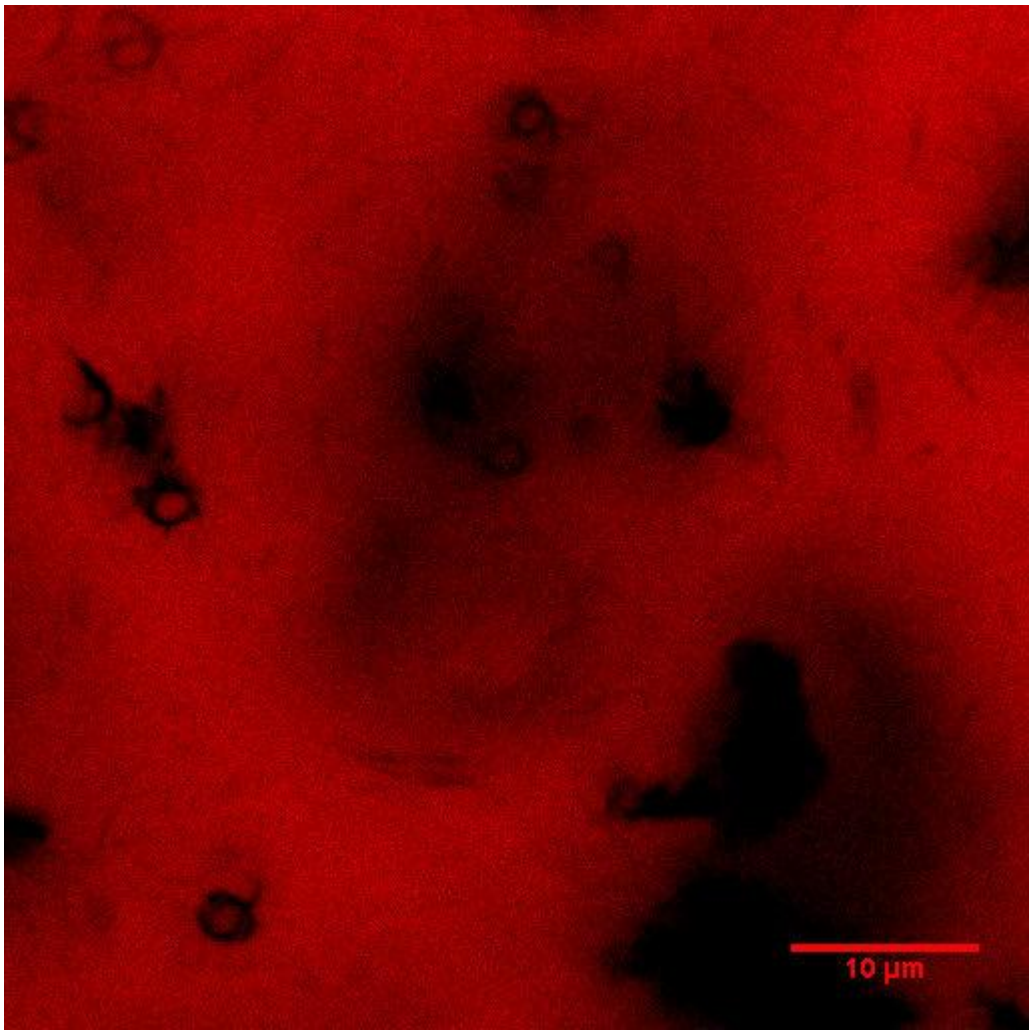

Fig S1: Enlarged image of Figure 2a for clearer viewing of the finer colloidal structures forming the network.

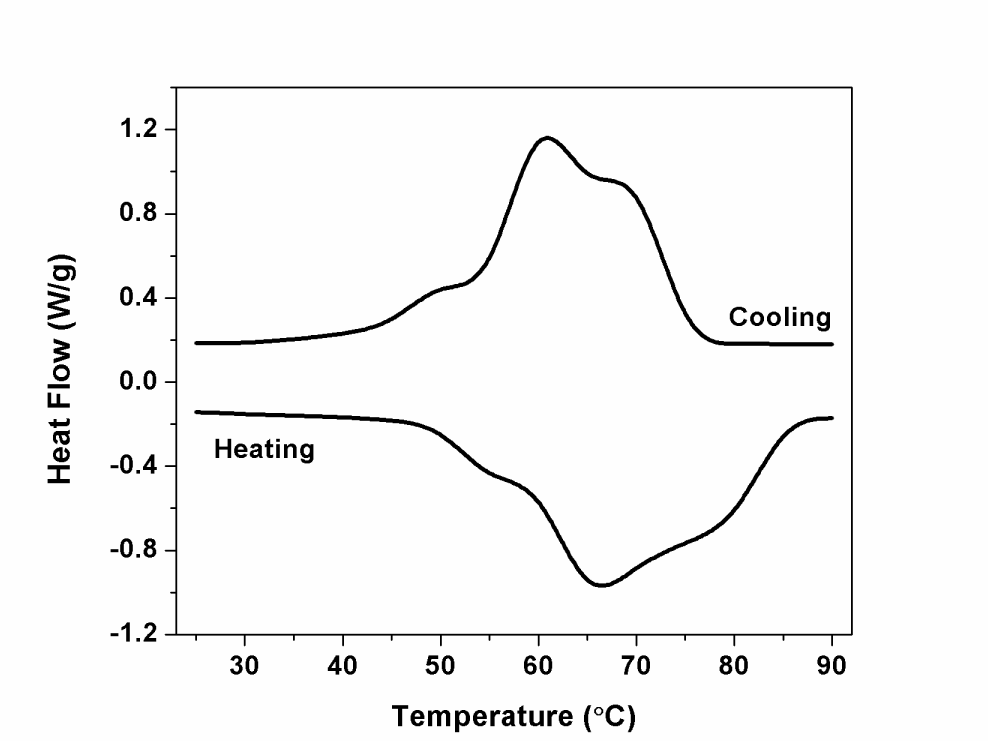

Fig. S2: DSC profile of shellac used in the study. The melting peaks at 55, 66.4 and 79.4 °C and the corresponding crystallization peaks at 69.9, 60.8 and 50.2 °C are attributed to the chemical composition of shellac.

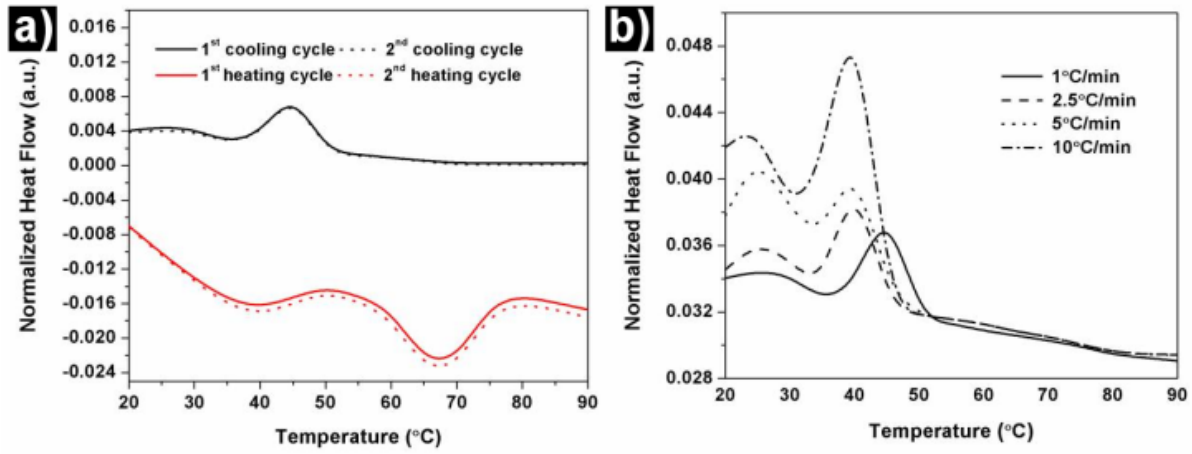

Fig. S3. a) DSC profiles of 2 %wt shellac oleogel during a consecutive cool-heat cycle at a constant rate of 5 °C/min; b) Normalized heat flow curves for 2 % wt shellac oleogel sample cooled at different rates.

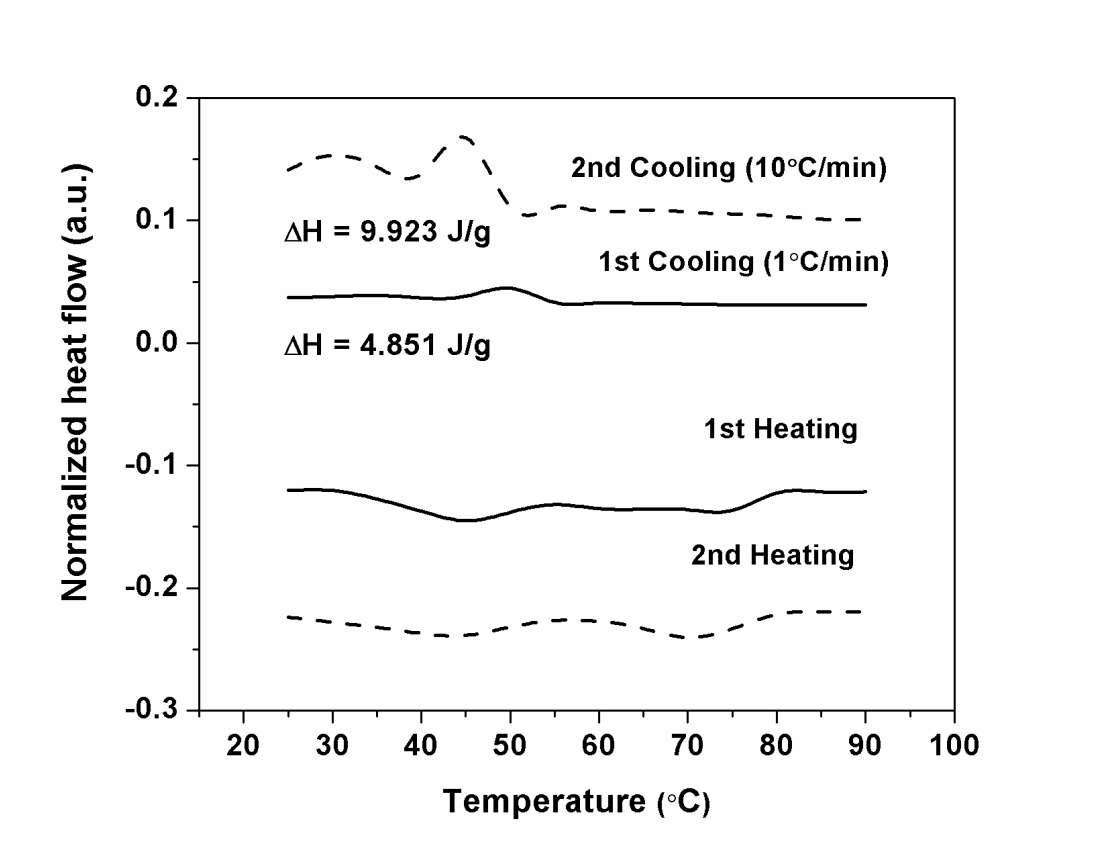

Fig. S4: Heating and cooling cycles of oleogels prepared using shellac at 5 %wt. The effect of cooling rate on thermal parameters (onset and crystallization temperature and the enthalpy of crystallization) was clearly seen.

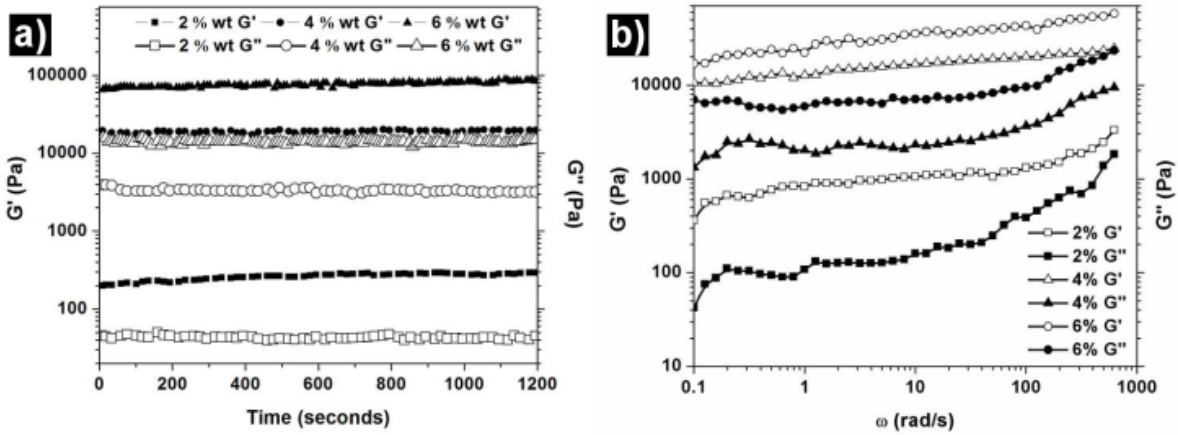

Fig. S5. a) Storage (G') and loss (G") moduli during time sweeps (at 0.25 Hz, 5 °C) for oleogels prepared at different shellac concentrations; b) Rheological data as a function of angular frequency (at 0.01% strain, 25 °C) for oleogels with 2, 4 and 6 %wt shellac.