Supporting Information

Thermal superinsulating materials made from nanofibrillated cellulose-stabilized Pickering emulsions

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NFC size distribution

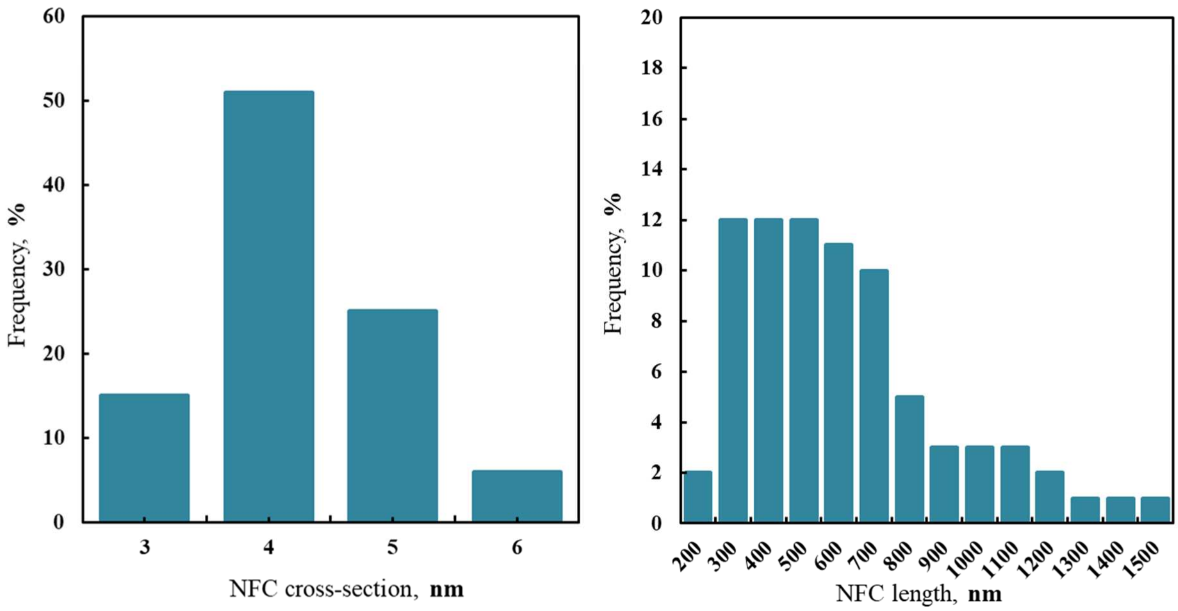

Figure S 1. NFC cross-section and length distribution

Calibration of hot strip device

Thermal conductivity, λ, of the sample is measured in the steady state from measurement of the strip-aluminum case conductance. Thermal conductance K is the ratio between the electrical power dissipated by the strip and the temperature difference between the strip and the aluminum case. The value of K is related to the thermal conductivity of the sample following a linear law: $K = A + B\lambda$ where A and B are constants determined by a calibration that involves the measurement of a variety of materials whose thermal conductivity are known.

The materials used to calibrate the device are polycarbonate, wood, cook and 4 different polyurethane foams, all of them are industrial and commercial materials so their thermal conductivity is known. Furthermore, in order to have a solid calibration these reference materials are characterized in parallel. First, the thermal conductivity λ and the thermal resistance r_{th} were measured with a guarded hot plate apparatus according to ISO 5085-1. The thermal resistance, r_{th} and the thermal conductivity, λ are calculated once steady state is reached that is to say when the flux density φ delivered by the heating element and both the hot and cold temperatures are constant.

Secondly, thermal diffusivity was measured with a MicroFlash NETZSCH model LFA 457 equipped with a liquid-nitrogen cooled InSb infrared detector and a Nd:YAG laser. The measurement of thermal diffusivity in combination with the determination of specific capacity and bulk density allows, by calculation of their scalar product, a direct determination of the thermal conductivity according to equation (1):

$$\lambda = \rho \, c_p^{\,m} \, a \qquad (1)$$

The specific capacity c_p^m was measured with a microcalorimeter (Setaram µDSC3 evo) for a temperature range between 0°C and 40°C. A mean value is deduced at 20°C, by integrating the signal. Bulk density of reference materials was measured with an analytical balance Mettler Toledo XS. In summary, the thermal conductivity of reference materials is measured directly by a guarded hot plate apparatus and compare with the numerical solution obtained from the experimental measurement of the thermal diffusivity, the specific capacity and the bulk density. The thermal conductivity obtained from these different and robust methods is the same and it is used in the calibration of the hot-strip device (Figure S2).

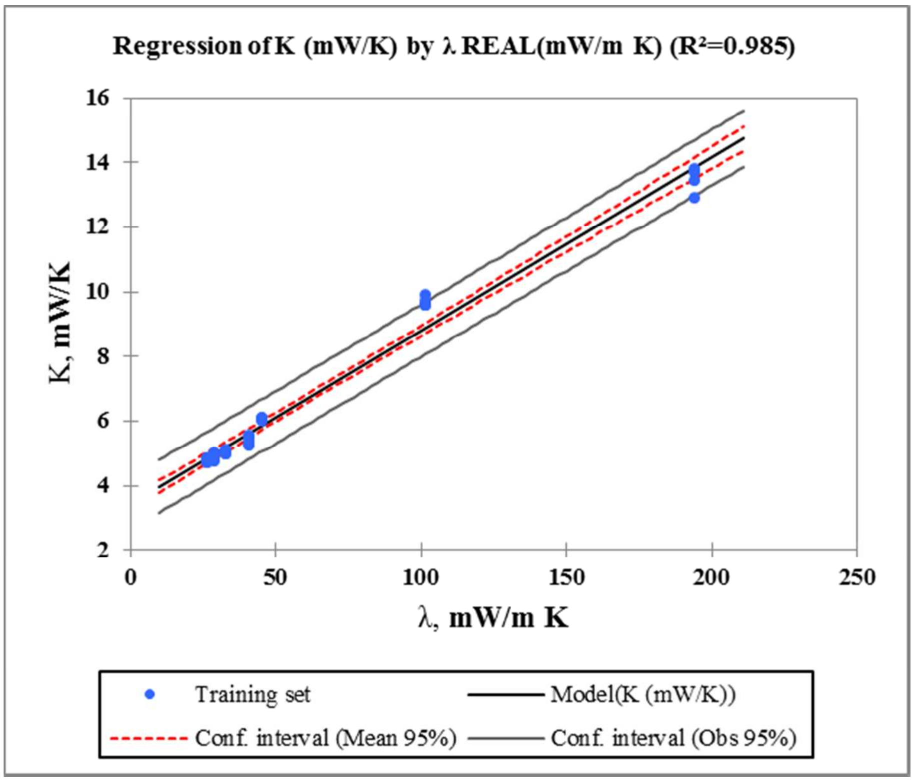

Figure S 2. Linear regression of the thermal conductance, K depending on the total thermal conductivity, λ of the reference materials ($R^2 = 0.985$).

Microstructural characteristics of bioaerogels.

NFC concentration in solution	Bulk density	S_{BET}	V_{theor}	V_{exp}	L_{max}	L_{mean}	L_p
g/L	g/cm^3	m^2/g	cm^3/g	cm^3/g	nm	nm	nm
10	0.012	64.18	81.54	0.19	31.5	17.2	11.7
15	0.014	26.16	72.42	0.06	28.6	18.4	9.5
20	0.020	22.44	49.48	0.06	28.9	14.5	10.1
25	0.024	20.54	40.96	0.05	28.7	14.9	9.5
30	0.029	13.63	33.74	0.04	46.3	14.5	11.2

Figure S 3. Microstructural characteristics of bioaerogels.