Electronic Supplementary Material (ESI) for Materials Horizons.

Frontally Polymerized Foams: Thermodynamic and Kinetical Aspects of Front Hindrance by Particles

Supplementary information

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Corrupted frontal regime

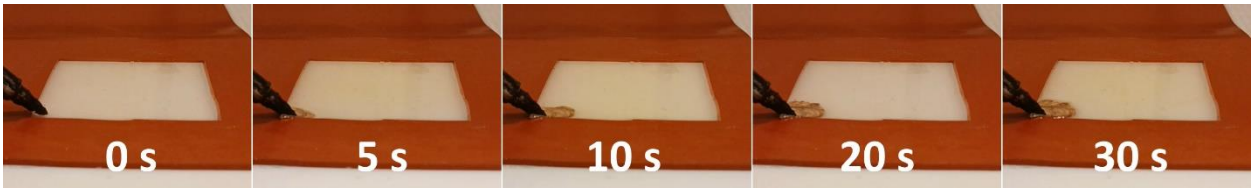

Fig. S1: Frontal regime of a standard FP foam formulation corrupted by adding 1 vol.% of 14 nm silica nanoparticles.

Differential scanning calorimetry

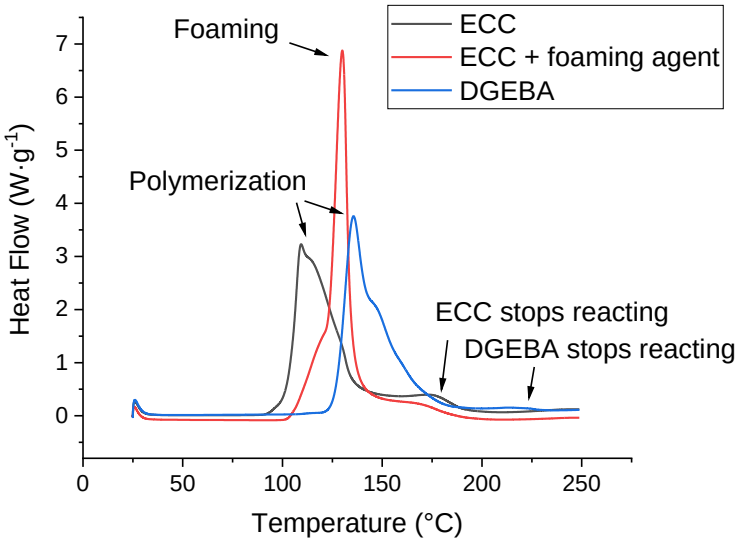

Fig. S2: DSC curves of ECC, ECC + foaming agent, and DGEBA with 2.5% IOC initiator which were used to identify the meaning of individual peaks in Fig. 2.

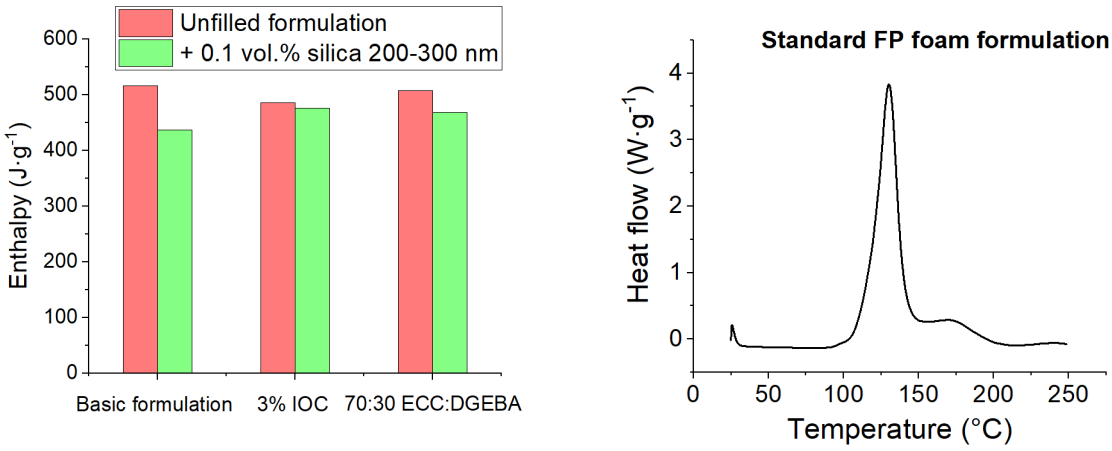

Fig. S3: Reaction enthalpies of frontally polymerized foams (left) and heat flow dependence on temperature (right) for curing of a standard FP foam formulation recorded by a regular DSC at a heating rate of 10°C·min^{-1} without modulation.

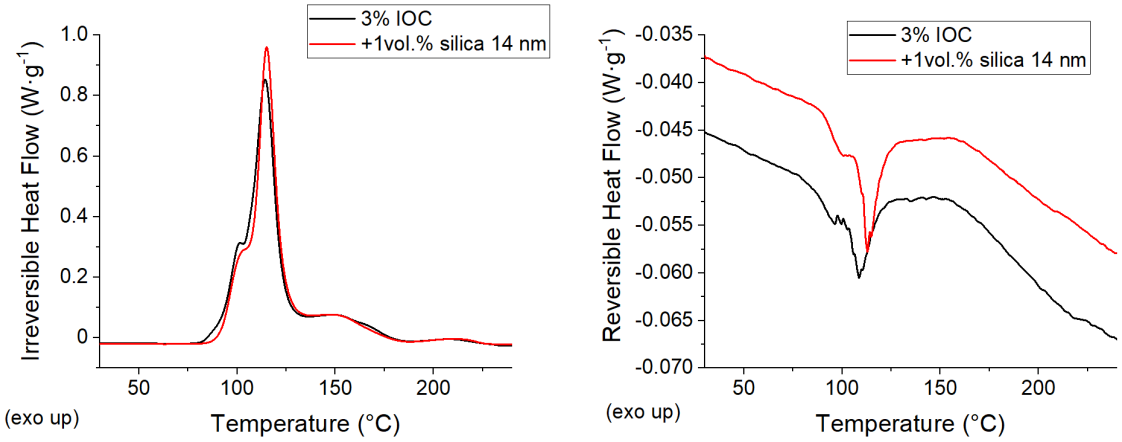

Fig. S4: Reversible (right) and irreversible (left) heat flow curve for 3% IOC sample filled with 1 vol.% of 14 nm silica nanoparticles and its unfilled reference obtained by M-DSC.

	H_{total}	$H_{rev.}$	$H_{irrev.}$	T_g (inflex)	C_p (50°C)
	J·g^{-1}	J·g^{-1}	J·g^{-1}	°C	J·g^{-1}·K^{-1}
3% IOC	602.2	1.117	595.4	94.68	1.927
+ 1 vol.% of silica 14 nm	579.2	2.097	576.7	95.12	1.775
Predicted difference	–13.0	–0.024	–12.8	-	–0.025
Real difference	–23.0	0.980	–18.7	0.44	–0.152
Real difference (%)	–3.8	87.7	–3.1	0.5	–7.9

Table S1: Total, reversible, and irreversible enthalpy, T_g, and heat capacity at 50°C for 3% IOC sample filled with 1 vol.% of 14 nm silica nanoparticles and its unfilled reference obtained by M-DSC. The predicted difference is based on the simple rule of mixture.

Thermal imaging

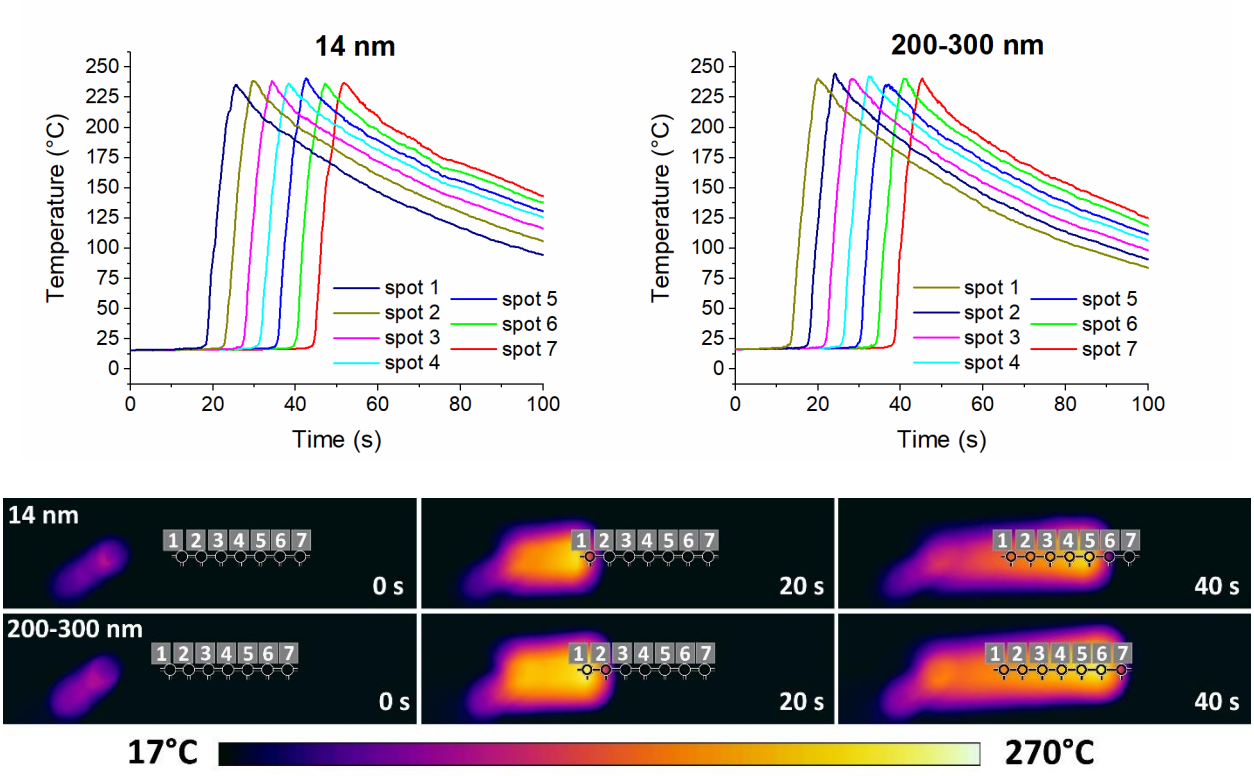

Fig. S5: Temperature profiles of the selected points during the frontal polymerization of the 3IOC formulation filled with 14 (top left) and 200–300 nm silica particles (top right) recorded by thermal imaging (bottom).

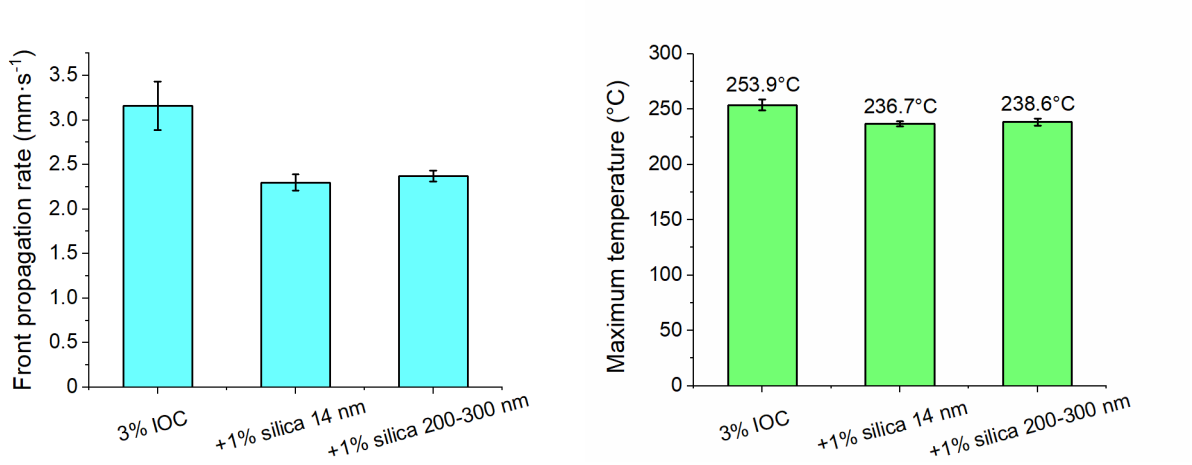

Fig. S6: Front velocity (left) and maximum temperature (right) recorded by thermal imaging for filled and unfilled samples.

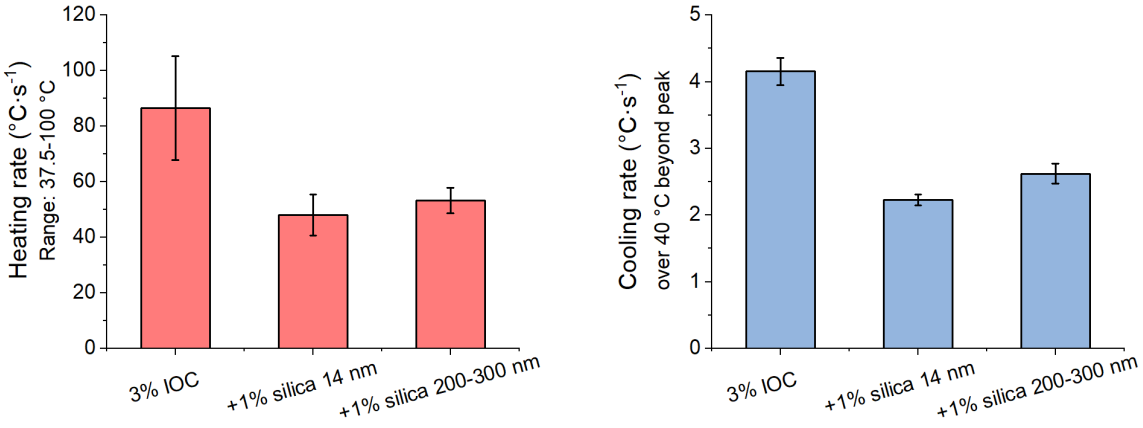

Fig. S7: Preheating rate in the range of 37.5–100°C (left) and post-curing cooling rate over 40°C beyond the peak temperature (right) recorded by thermal imaging for filled and unfilled samples.

Particle distribution

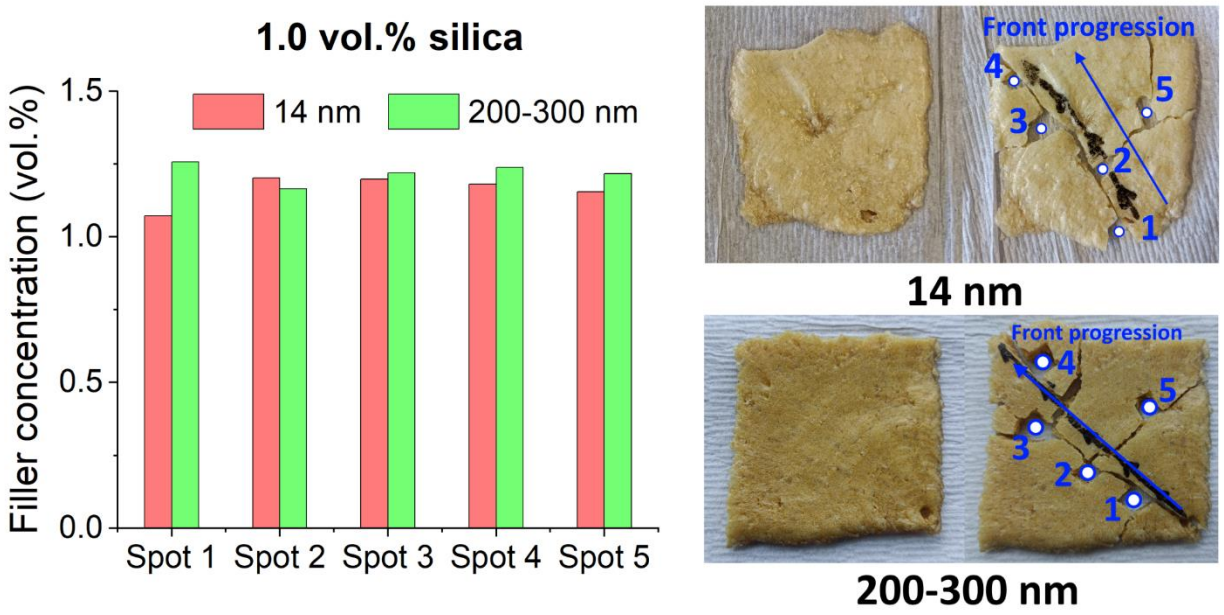

Fig. S8: Particle concentration of various specimens at 5 spots with a variable displacement from the initiating point (left). Image of unbroken and broken specimens before and after collecting the testing specimens with highlighted spot positions (right).