Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supplementary information for manuscript:

"Highly porous flame-retardant and sustainable biofoams based on wheat gluten and in-situ polymerized silica"

Table S1. Materials classification for UL94 vertical burning test

Criteria condition	Classification		
	V-0	V-1	V-2
Afterflame time for each individual specimen	≤10 s	≤30 s	≤30 s
Total afterflame time for all 5 specimens of any set	≤50 s	≤250 s	≤250 s
Flaming and glowing time for each specimen after second flame application	≤30 s	≤60 s	≤60 s
Afterflame or afterglow of any specimen up to the holding clamp	No	No	No
Cotton ignited by flaming particles or drops	No	No	Yes

Table S2. Results of UL94 vertical burning test of wheat gluten foams and wheat gluten biohybrid foams

Criteria Conditions	WG/–25					WG/5TEOS/–25				
	1	2	3	4	5	1	2	3	4	5
t_1	50	59	62	92	80	48	50	30	26	23
t_2	0	0	0	0	0	0	0	34	34	19.3
$t_1 + t_2$			343					264.3		
$t_2 + t_3$	0	0	0	0	0	0	0	34	35	19.3
Drip	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cotton ignition	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No
Classification			None					None		

Criteria Conditions	WG/20TEOS/–25					WG/30TEOS/–25				
	1	2	3	4	5	1	2	3	4	5
t_1	60.7	60.3	4	28	9.8	0	0	0	0	0
t_2	0	0	18	9.6	60.4	2.5	2.5	1	0	0
$t_1 + t_2$			250.8					6		
$t_2 + t_3$	0	0	18	9.6	60.4	2.5	2.5	1	0	0
Drip	Yes	Yes	No	Yes	Yes	No	No	No	No	No
Cotton ignition	No	No	No	No	Yes	No	No	No	No	No
Classification			None					V-0		

Criteria Conditions	WG/40TEOS/–25					WG/50TEOS/–25				
	1	2	3	4	5	1	2	3	4	5
t_1	0	0	0	1	0	0	0	1	1	0
t_2	0	0	1	0	0	2	0	0	0	0
$t_1 + t_2$			2					4		
$t_2 + t_3$	0	0	1	0	0	2	0	0	0	0
Drip	No	No	No	No	No	No	No	No	No	No
Cotton ignition	No	No	No	No	No	No	No	No	No	No
Classification			V-0					V-0		

Criteria Conditions	WG/20TEOS/–196					WG/30TEOS/–196				
	1	2	3	4	5	1	2	3	4	5
t_1	1	5	4	2	3	0	0	0	0	1
t_2	2	0	2.1	2	2.3	0	0	2	0	0
$t_1 + t_2$			23.4					3		
$t_2 + t_3$	7	18.3	18.1	4	14.3	0	0	2	0	0
Drip	No	No	No	No	No	No	No	No	No	No
Cotton ignition	No	No	No	No	No	No	No	No	No	No
Classification			V-0					V-0		

Criteria Conditions	WG/10TEOS/8GA/–25					WG/20TEOS/8GA/–25				
	1	2	3	4	5	1	2	3	4	5
t_1	3	7.6	2.4	6.8	5.6	0	0	0	0	1
t_2	21.1	24.4	28.3	19.3	27	2	0	0	0	0
$t_1 + t_2$			145.5					3		
$t_2 + t_3$	21.1	24.4	28.3	19.3	27	2	0	0	0	0
Drip	No	No	No	No	No	No	No	No	No	No
Cotton ignition	No	No	No	No	No	No	No	No	No	No
Classification			V-1					V-0		

Criteria Conditions	WG/30TEOS/8GA /–25				
	1	2	3	4	5
t_1	0	0	0	0	0.5
t_2	0	0.8	1.1	0	0
$t_1 + t_2$			2.4		
$t_2 + t_3$	2	0.8	1.1	0	0
Drip	No	No	No	No	No
Cotton ignition	No	No	No	No	No
Classification			V-0		

t_1: afterflame time for individual specimen after first flame application;
t_2: afterflame time for individual specimen after second flame application;
$t_1 + t_2$: total afterflame time for any condition set (five specimens);
t_3: afterglow time for individual specimen after second flame application;
$t_2 + t_3$: afterflame plus afterglow time for individual specimen after the second flame application.

Fig. S1 TG curves of the pristine WG foam and the WG-based hybrid foam prepared at –25°C.

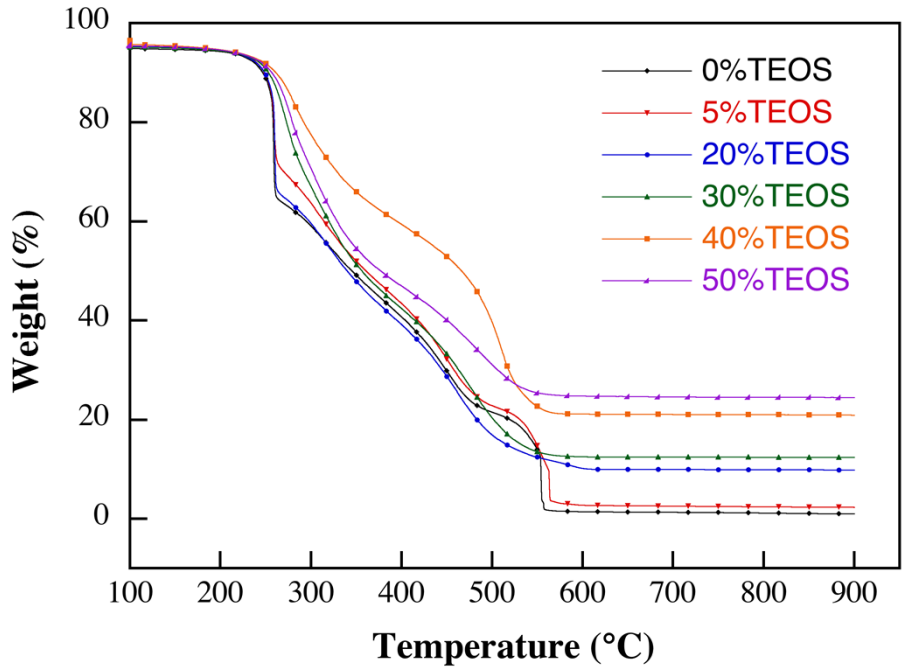

Fig. S1 TG curves of WG/–25, WG/5TEOS/–25, WG/20TEOS/–25, WG/30TEOS/–25, WG/40TEOS/–25, WG/50TEOS/–25 foams

Table S3. Residue amounts and corresponding SiO_2 contents of WG foam and WG-based hybrid foams from TGA evaluation (oxygen, 900 °C).

Sample	Theoretical SiO_2 (%)	Residue (%) at 900 °C	Normalized SiO_2 residue (%) at 900 °C
WG/50TEOS/–25	22.4	24.8	24.2
WG/40TEOS/–25	16.1	21.1	20.4
WG/30TEOS/–25	11.0	12.6	11.8
WG/20TEOS/–25	6.7	10.1	9.1
WG/5TEOS/–25	1.5	2.6	1.5
WG/–25	0	1.2	0

Table S3. summarizes outcome of the TG evaluation with theoretical SiO_2 content based on complete condensation of the TEOS, the mass related to the residues after TG, and the normalized SiO_2 content after TG based on the initial amount of theoretical SiO_2 (corrected for the ash formed during the heat treatment under oxygen).