

Supporting Information For

Carbon/ZrO₂ Aerogel Composite Microtube Superfoam

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Fig. S1 The image of the cellulose microtube.



Fig. S2 The image of the ZrO₂ aerogel precursor solution (5%).

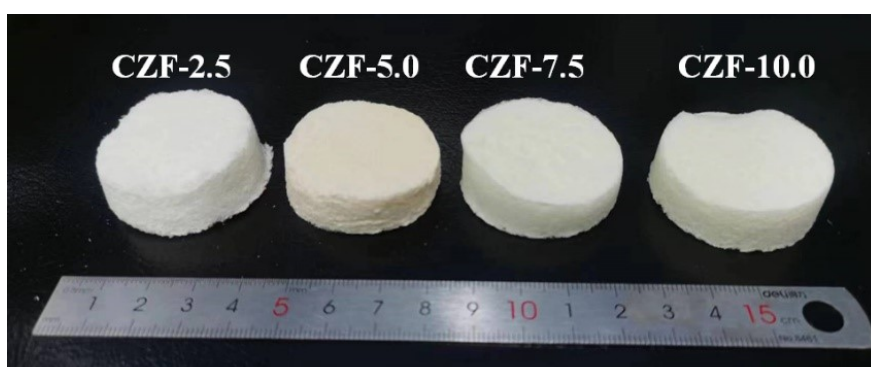


Fig. S3 The image of the CZF-X superfoam.

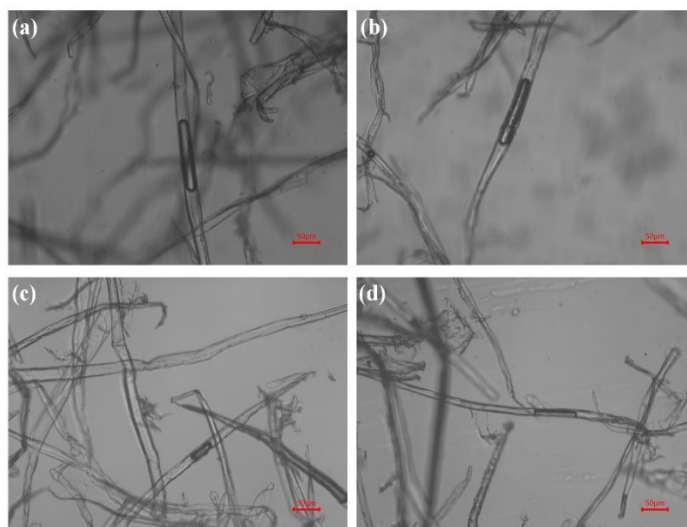


Fig. S4 Bubbles that appear transiently in cellulose microtubules after the precursor solution

2.5%(a), 5.0%(b), 7.5%(c), and 10.0%(d) is adsorbed by cellulose microtubules.

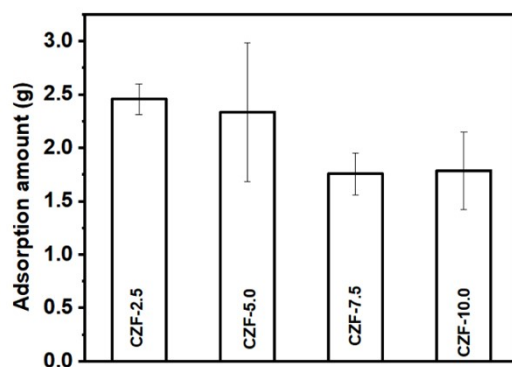


Fig. S5 The mass of the different ZrO_2 aerogel precursor solution adsorbed by cellulose

microtubules (0.5 g).

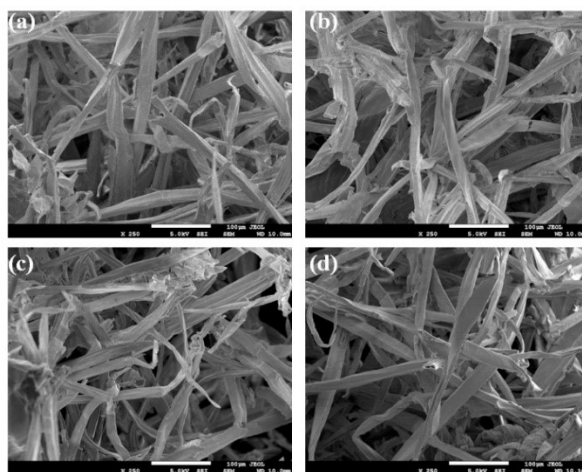


Fig. S6 SEM image of the CZF-X superfoam.

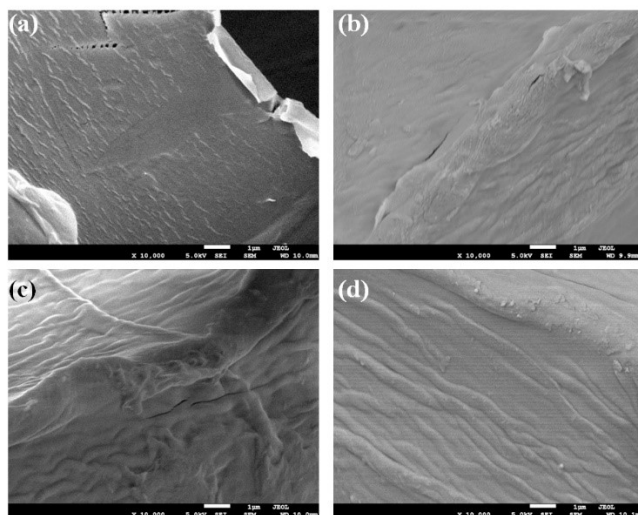


Fig. S7 SEM image of the CZF-X superfoam.

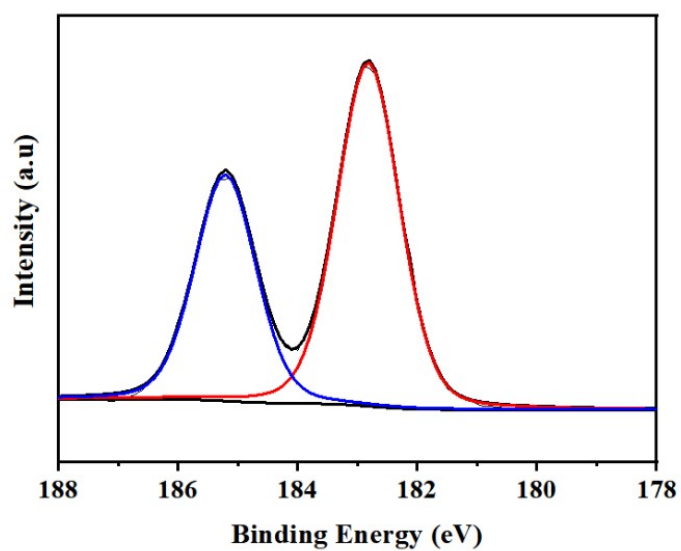


Fig. S8 the high resolution Zr 3d spectrum of the CZF-5.0 superfoam.

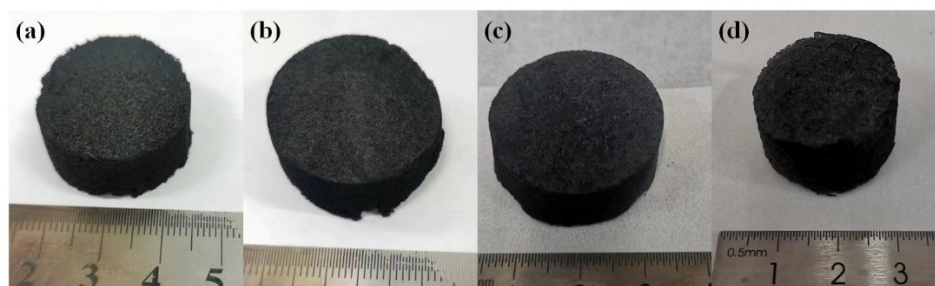


Fig. S9 The image of the CZF-5.0-600 (a), CZF-5.0-800 (b), CZF-5.0-1000 (c), and CZF-5.0-1200 (d) superfoam.

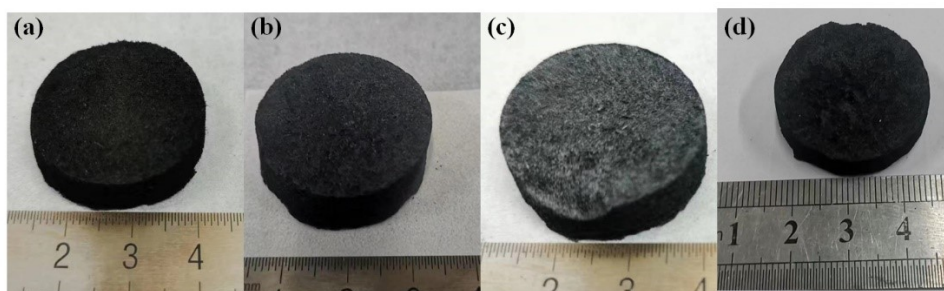


Fig. S10 The image of the CZF-2.5-1000 (a), CZF-5.0-1000 (b), CZF-7.5-1000 (c), and CZF-10.0-1200 (d) superfoam.

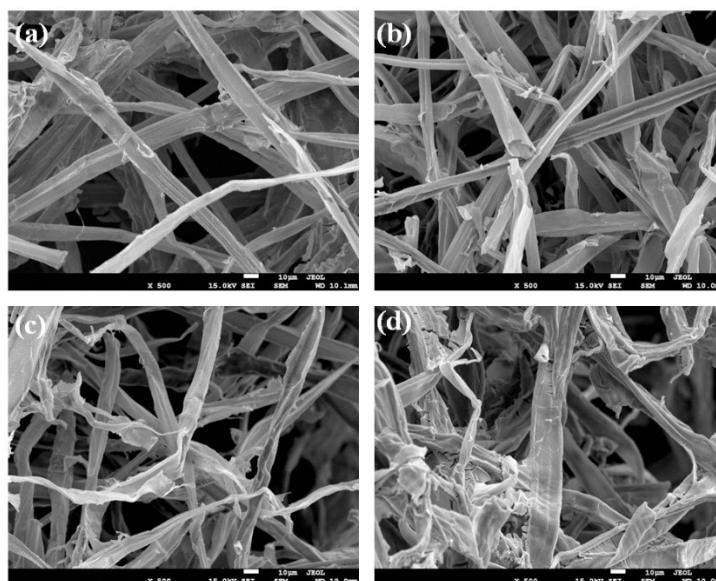


Fig. S11 The SEM image of the CZF-5.0-600 (a), CZF-5.0-800 (b), CZF-5.0-1000 (c), and CZF-5.0-1200 (d) superfoam.

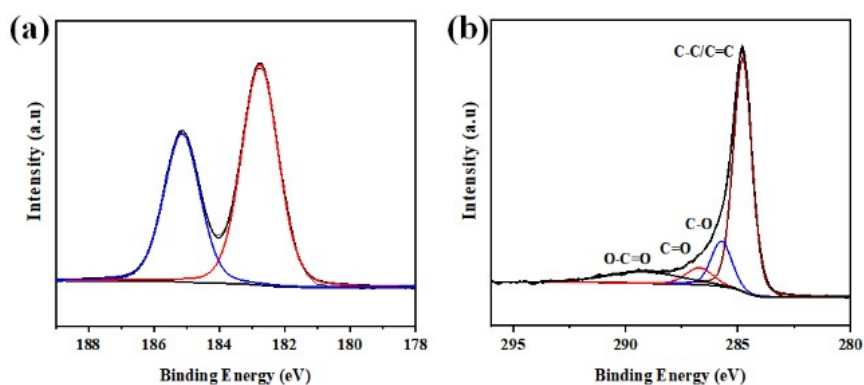


Fig. S12 The high resolution Zr 3d and C 1s spectrum of the CZF-5.0-1000 superfoam.

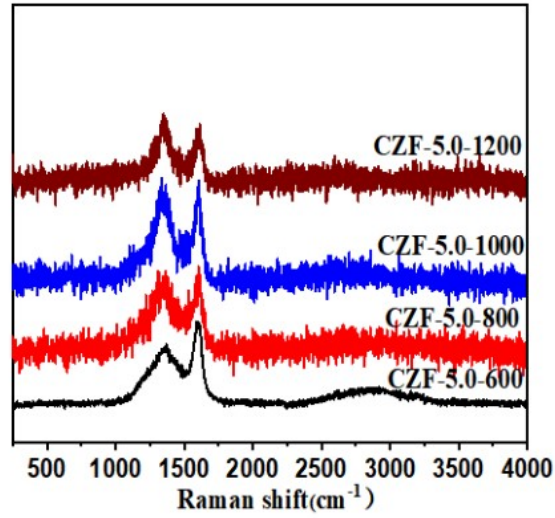


Fig. S13 The Raman spectra of the CZF-5.0-X superfoam.

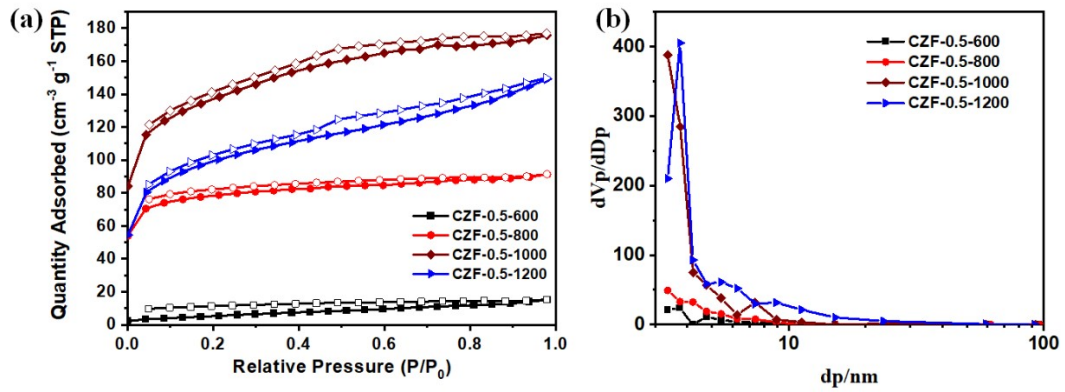


Fig. S14 N₂ adsorption-desorption isotherm (a) and pore size distribution (b) of the CZF-5.0-Y superfoam.

Table S1 The pore structure parameters of the CZF-5.0-Y superfoam.

Sample	S_{BET} (m ² g ⁻¹)	V_{total} (cm ³ g ⁻¹)	D_{average} (nm)
CZF-5.0-600	20	0.0234	4.5
CZF-5.0-800	295	0.1413	1.9
CZF-5.0-1000	494	0.2717	2.2
CZF-5.0-1200	353	0.2306	2.6

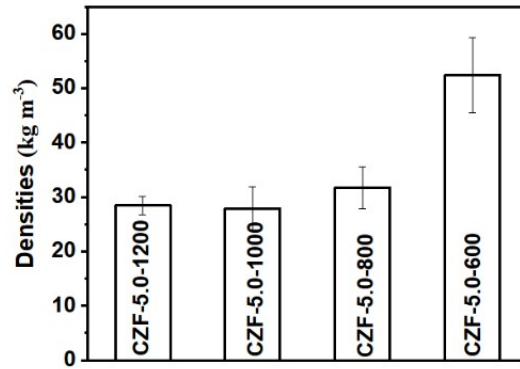


Fig. S15 The density of the CZF-5.0-600 (a), CZF-5.0-800 (b), CZF-5.0-1000 (c), and CZF-5.0-1200 (d) superfoam.

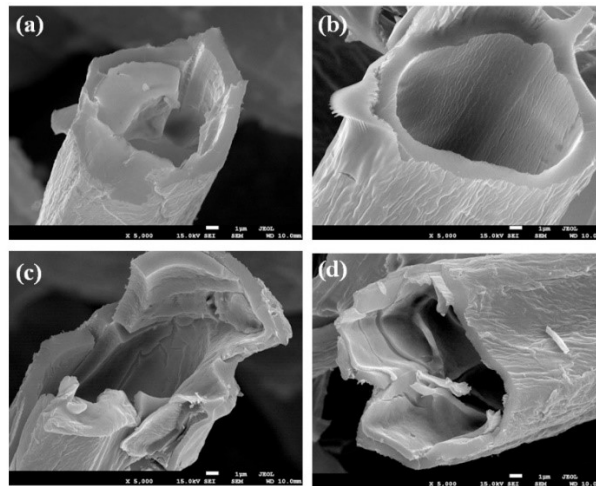


Fig. S16 SEM image of the CZF-2.5-1000 (a), CZF-5.0-1000 (b), CZF-7.5-1000 (c), and CZF-10.0-1200 (d) superfoam.

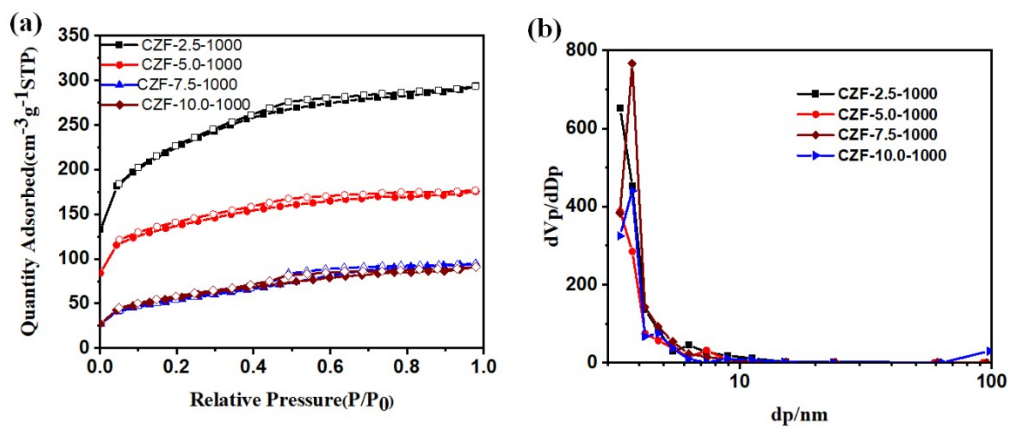


Fig. S17 N₂ adsorption-desorption isotherm (a) and pore size distribution (b) of the CZF-5.0-Y superfoam.

Table S2 The pore structure parameters of the CZF-5.0-Y superfoam.

Sample	S_{BET} ($\text{m}^2 \text{g}^{-1}$)	V_{total} ($\text{cm}^3 \text{g}^{-1}$)	D_{average} (nm)
CZF-2.5-1000	796	0.4541	2.3
CZF-5.0-1000	494	0.2717	2.2
CZF-7.5-1000	188	0.1457	3.1
CZF-10.0-1000	198	0.1412	2.8

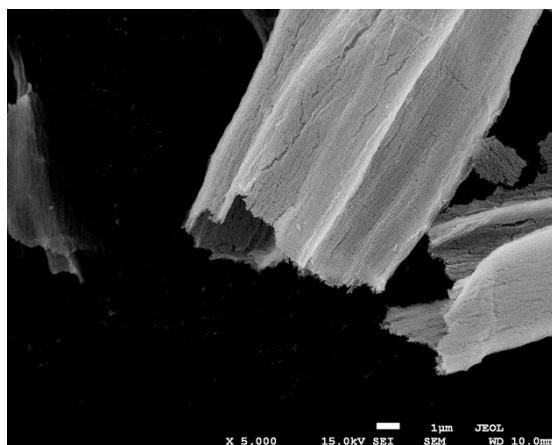


Fig. S18 SEM image of the of ZrO_2 microtubes on ablation surface of the CZF-5.0-1000.