

Supplementary Information for

Advanced lightweight lightning strike protection composites based on super-aligned carbon nanotube films and thermal-resistant zirconia fibers

Text S1: Preparing process of SA-CNTF.

A chemical vapor deposition (CVD) method was employed to synthesize superaligned CNT arrays with a height of 0.3 mm on eight-inch silicon wafers. A single layer of SA-CNTF was extracted from an array using a dry method and placed on a glass substrate, ensuring the CNTs were aligned parallel to the drawing direction. By stacking multiple layers in parallel and shrinking them with ethanol, multilayer SA-CNTFs (dimensions: 300 mm * 300 mm) were produced. For a 1000-layer SA-CNTF, the areal density and the thickness reached approximately 20 g/m² and 30 μm, respectively.

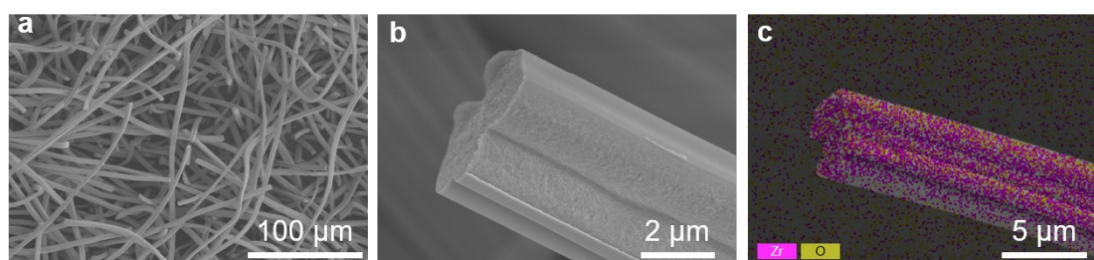


Figure S1. Typical morphology of the zirconia fiber. (a,b) SEM image of zirconia fiber paper. (c) EDS of zirconia fiber paper.

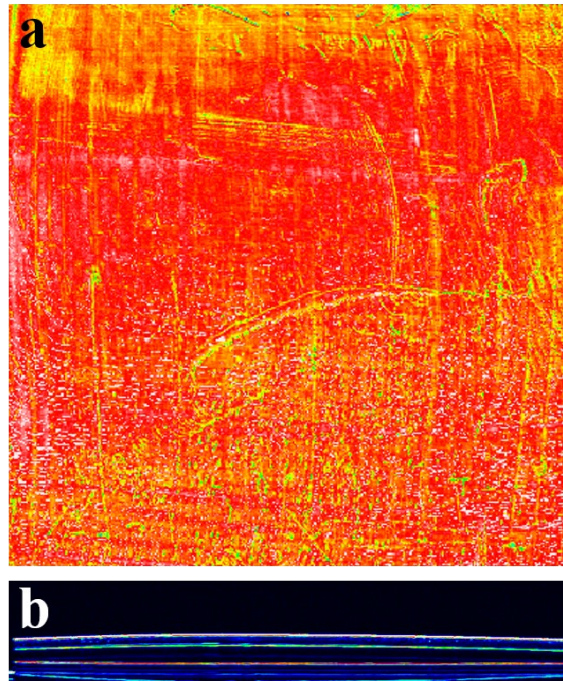


Figure S2. Ultrasonic characterization before lightning strikes. (a) Typical C-scan image. (b) Typical B-scan image.

Table S1. Surface electrical resistivity of LSP laminate samples.

No	Name	Electrical resistivity (Ω/\square)
1	Z1	> 1M
2	Z1C1000	2.56
3	Z1C1200	1.85

Table S2. Relevant parameters for calculating thermal conductivity of several isolation layer with CFRP

Isolation layer with CFRP	Specific heat capacity J/(g*K)	Thermal diffusion coefficient mm ² /s	Thermal conductivity W/m*K
Glass fiber	1.12	0.406	0.7102

Quartz fiber	1.17	0.458	0.7823
ZrO ₂ fiber	1.05	0.510	0.6821
