**Figure S1** Preparation and functionalization process of LEGO® building blocks

**Figure S2** The sample fabricated with small pressure

**Figure S3** The sample fabricated with low temperature

**Figure S4** The sample fabricated with high temperature

**Figure S5** SEM image of the BN-ANF protective layer

**Figure S6** TEM image of BN-ANF

**Figure S7** The SEM of BN-ANF and the Boron element mapping

**Figure S8** SEM image of the ANF base layer

**Figure S9** SEM image of the CNT conductive layer

**Figure S10-S14** EDS analysis of different layer

**Figure S15** Photograph and graphic illustration of the ultrathin sample

**Figure S16** Burning residuals of the samples with or without protection layer

**Figure S17** The schematic diagram of the fire alarm circuit

**Figure S18** Electrical insulation properties of the samples with protection layer

**Figure S19** Surface Temperature Distribution with or without protection layer

**Table S1** EDS analysis of the upper layer in figure 2e

**Table S2** EDS analysis of the middle layer in figure 2e

**Table S3** EDS analysis of the bottom layer in figure 2e

**Table S4** EDS analysis of the upper layer in figure 2g

**Table S5** EDS analysis of the bottom layer in figure 2g

**Table S6** Fire alarm performance comparison with other reported works
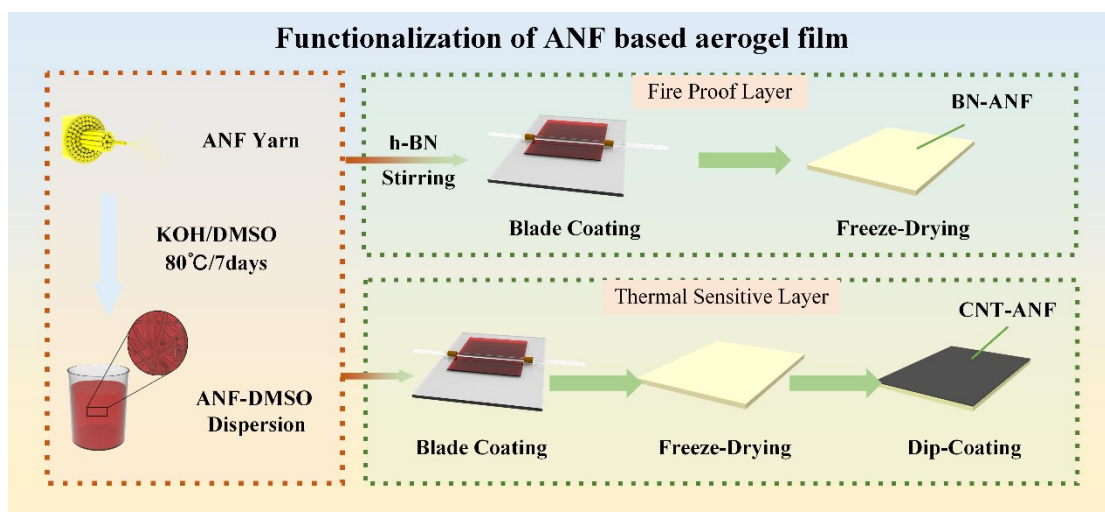
Figure S1 Preparation and functionalization process of LEGO® building blocks



Figure S2. The sample fabricated with small pressure



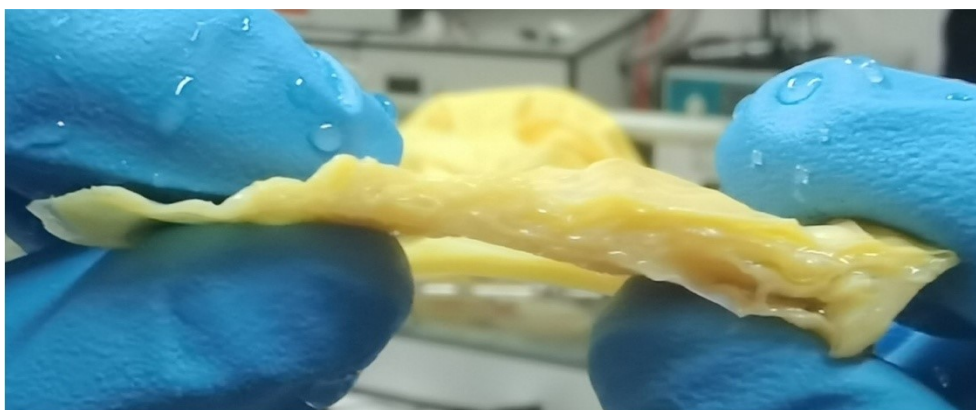Figure S3. The sample fabricated with low temperature

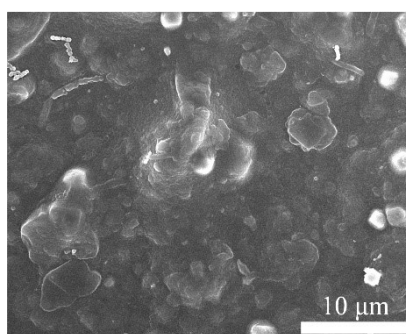Figure S4. The sample fabricated with high temperature



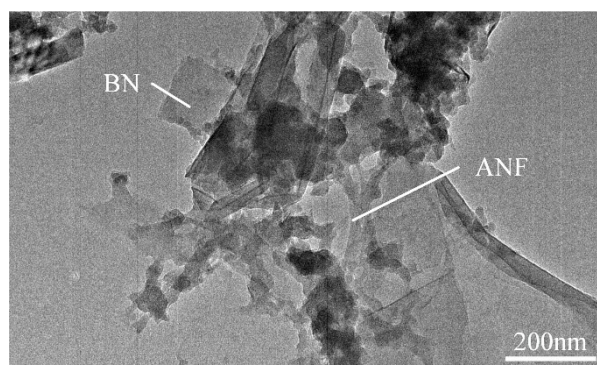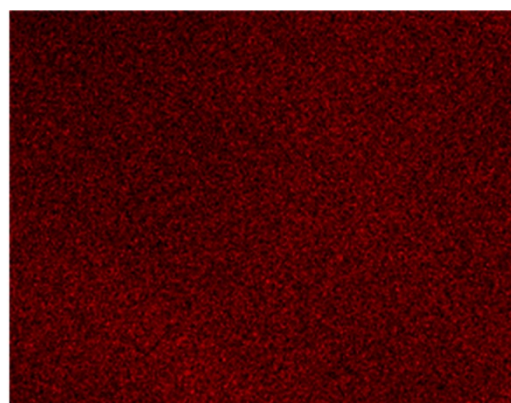Figure S5 SEM image of the BN-ANF protective layer


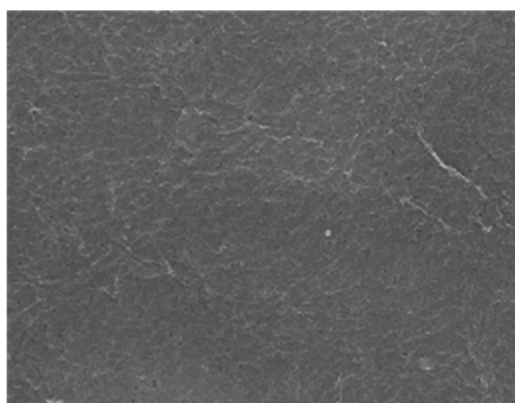
Figure S6. TEM image of BN-ANF

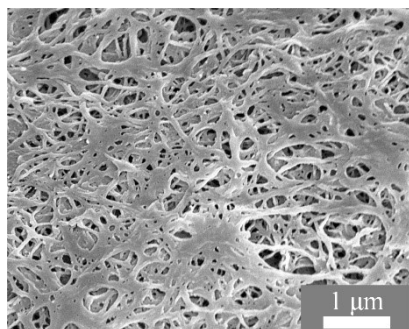Figure S7. The SEM of BN-ANF and the Boron element mapping
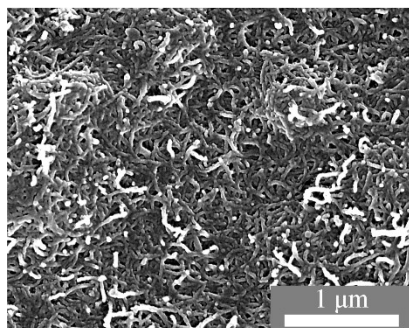


Figure S8 SEM image of the ANF base layer



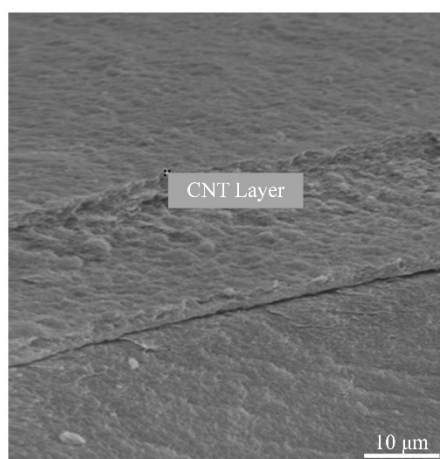Figure S9 SEM image of the CNT conductive layer



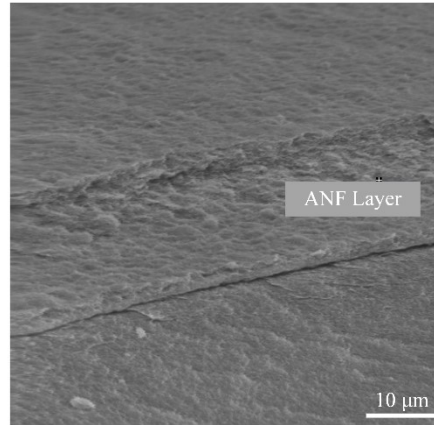Figure S10 EDS analysis of the upper layer in figure 2e.

Figure S11 EDS analysis of the middle layer in figure 2e
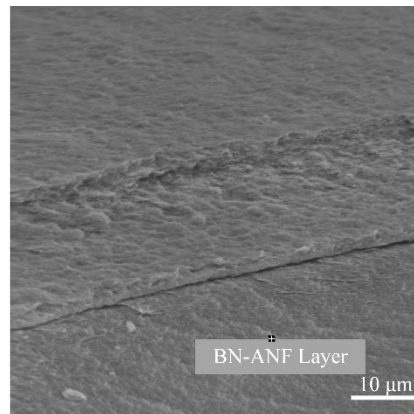


Figure S12 EDS analysis of the bottom layer in figure 2e



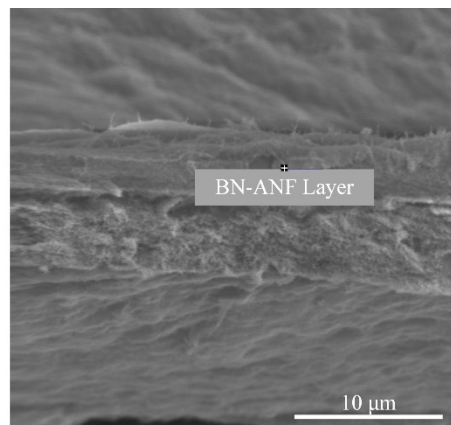Figure S13 EDS analysis of the upper layer in figure 2g
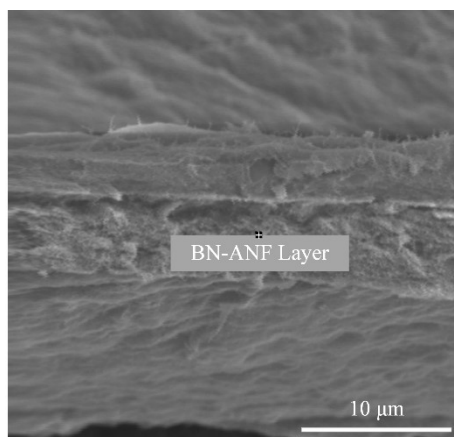
Figure S14 EDS analysis of the bottom layer in figure 2g



Figure S15 Photograph and graphic illustration of the ultrathin sample

Figure S16 Burning residuals of the samples with or without protection layer



Figure S17 The schematic diagram of the fire alarm circuit



Figure S18 Electrical insulation properties of the samples with protection layer

| Without Protection Layer | With Protection Layer |
|---|---|
| 85.7 | 85.21 |

Figure S19 Surface Temperature Distribution with or without protection layer

Table S1 EDS analysis of the upper layer in figure 2e

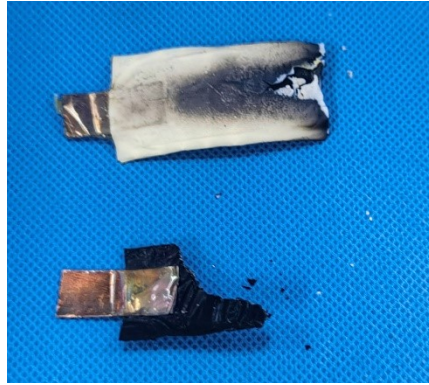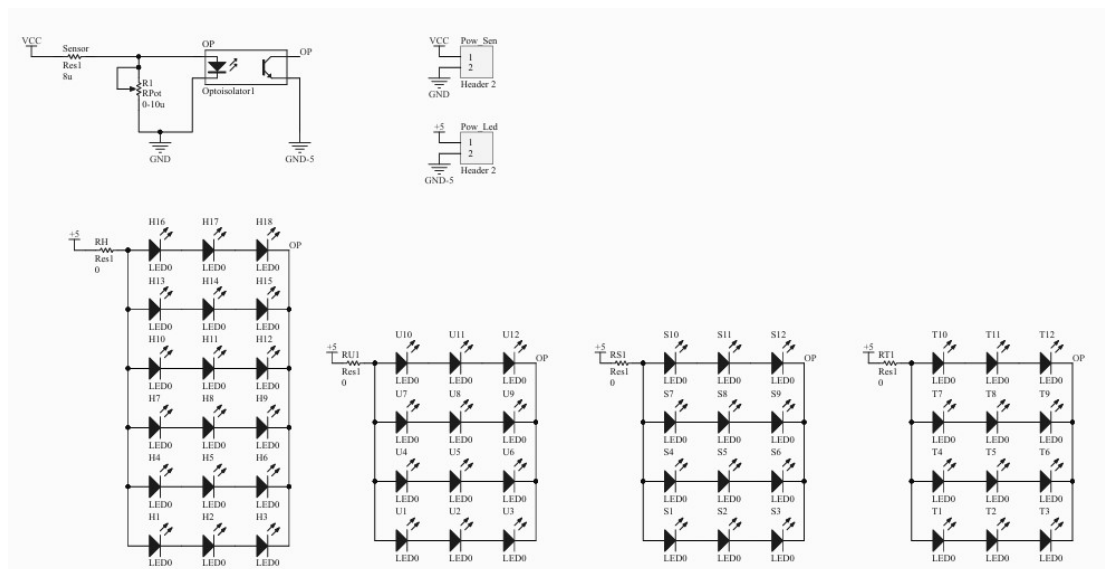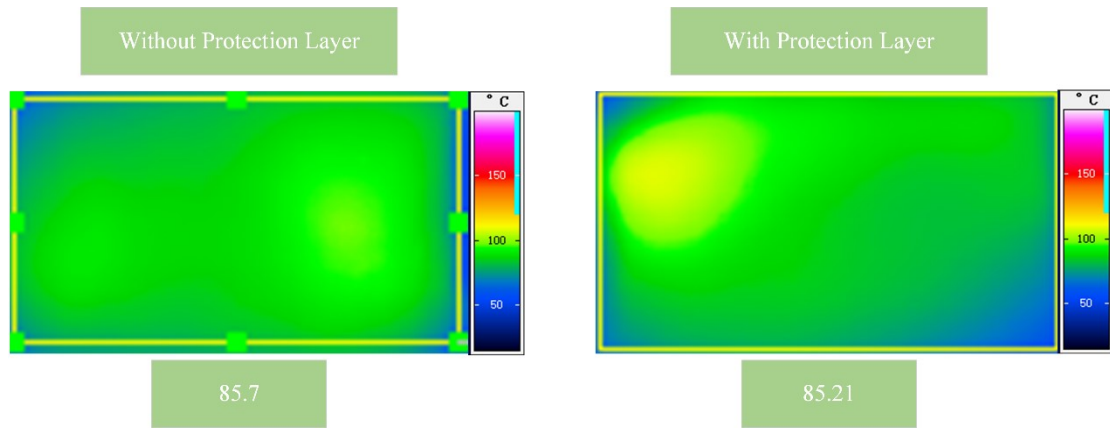| Element | Weight Percentage | Atom Percentage |
|---------|-------------------|-----------------|
| Boron | 0 | 0 |
| Carbon | 100 | 100 |

Table S2 EDS analysis of the middle layer in figure 2e

| Element | Weight Percentage | Atom Percentage |
|---------|-------------------|-----------------|
| Boron | 0 | 0 |
| Carbon | 100 | 100 |

Table S3 EDS analysis of the bottom layer in figure 2e

| Element | Weight Percentage | Atom Percentage |
|---------|-------------------|-----------------|
| Boron | 7.75 | 8.53 |
| Carbon | 92.25 | 91.47 |

Table S4 EDS analysis of the upper layer in figure 2g

| Element | Weight Percentage | Atom Percentage |
|---------|-------------------|-----------------|
| Boron | 8.6 | 9.47 |
| Carbon | 91.4 | 90.53 |

Table S5 EDS analysis of the bottom layer in figure 2g

| Element | Weight Percentage | Atom Percentage |
|---------|-------------------|-----------------|
| Boron | 0 | 0 |
| Carbon | 100 | 100 |

Table S6 Fire alarm performance comparison with other reported works[1-6]

| Name | Response Time(s) | Duration(s) | Reference |
|------|------------------|-------------|-----------|
| SSFS | 4 | 22 | [1] |
| TA-MoS$_2$ | 4.9 | >1200 | [2] |
| BCGP | 3.6 | >150 | [3] |
| HTE@CF-4 | 3 | >60 | [4] |
| AM@Bamboo | 5.3 | 120 | [5] |
| GO-HNT | 8 | >1200 | [6] |
| This Work | 3 | >1200 | This work |

# References

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4  Q. Zeng, B. Wang, X. Lai, H. Li, Z. Chen, H. Xie and X. Zeng, *Composites Part A: Applied Science and Manufacturing*, 2023, **164**, 107305.

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