Supplementary Information

Flame-retardant MXene/Polyimide Film with Outstanding Thermal and Mechanical Properties Based on the Secondary Orientation Strategy

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Fig. S1 Typical stress-strain curves of PI film and MXene/PI films.

Fig. S2 SEM images of a) MXene/PI film, b) burned MXene/PI film and energy dispersive spectroscopy (EDS) mapping images of C, N, O, F, and Ti elements. EDS element spectrum and atomic percentage of c) MXene/PI and d) burned MXene/PI.
Table S1 Micro-scale Combustion Calorimeter (MCC) data of all samples.

| Sample          | HR Capacity (J/g-K) | Peak HRR (W/g) | Total HR (kJ/g) | Temperature (℃) |
|-----------------|---------------------|----------------|-----------------|-----------------|
| PI              | 75                  | 47.6           | 0.9             | 556             |
| MXene-10/PI     | 54                  | 37             | 0.8             | 562.1           |
| MXene-20/PI     | 28                  | 22.7           | 0.8             | 563.1           |
| MXene-30/PI     | 27                  | 16.9           | 0.9             | 565.7           |
| MXene-40/PI     | 26                  | 12.8           | 0.7             | 572.7           |

Table S2 Comparison of properties of different PI composite materials.

| Materials            | Preparation method/condition | Thermal conductivity (W m$^{-1}$ k$^{-1}$) | Tensile strength (MPa) | Literature |
|----------------------|------------------------------|---------------------------------------------|-------------------------|------------|
| BN/PI film           | Casting method               | 1.16                                        | ~69.6                   | 1          |
| AIN/BN/PI film       | Casting method               | 0.711                                       | ~120.1                  | 2          |
| NH$_2$-rGO/PI film   | Knife Coating method         | 7.13                                        | 35.7                    | 3          |
| CNF/hBN/PI film      | Dip Coating method           | 0.627                                       | ~70                     | 4          |
| G/PI film            | Knife Coating method         | 0.2275                                      | ~127.5                  | 5          |
| PI/GO/BN film        | Casting method               | 11.203                                      | —                       | 6          |
| rGO/PI film          | Casting method               | 2.78                                        | —                       | 7          |
| BN/PI film           | Casting method               | 2.58                                        | —                       | 8          |
| PI/CNNS film         | Solution Casting method      | 2.04                                        | —                       | 9          |
| Hyperbranched PI film| Knife Coating method         | —                                          | 124.1                   | 10         |
| PI/FGS film          | Casting method               | —                                          | ~122                    | 11         |
| Film Type         | Coating Method       | T | ΔT  | Work Type   |
|-------------------|----------------------|---|-----|-------------|
| ZnS-MPTMS/PI film| Knife Coating method| — | ~87.7| 12          |
| FG/PI film        | Casting method       | — | 65.76| 13          |
| MXene/PI film     | Secondary Orientation Strategy | ~5.12 | ~102 | Our work    |

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