SUPPORTING INFORMATION

Enhanced Thermal Conductivity for Polyimide Composites with a Three-Dimensional Silicon Carbide Nanowires@Graphene Sheets Filler

Wen Dai[1], Jinhong Yu[1,2]*, Yi Wang[1], Yingze Song[1], Fakhr E Alam[1], Kazuhito Nishimura[3], Cheng-Te Lin[1]*, Nan Jiang[1]*

[1]*Key Laboratory of Marine New Materials and Related Technology, Zhejiang Key Laboratory of Marine Materials and Protection Technology, Ningbo Institute of Material Technology and Engineering, Chinese Academy of Sciences, Ningbo 315201, China*

[2]*Key Laboratory of New Processing Technology for Nonferrous Metals and Materials, Ministry of Education, School of Material Science and Engineering, Guilin University of Technology, Guilin 541004, China.*

[3]*Advanced Nano-processing Engineering Lab, Mechanical Systems Engineering, Kogakuin University, Kochi, 780-0805, Japan*

Corresponding author. Tel:+86 574 86685171, E-mail address: **yujinhong@nimte.ac.cn*

*Tel:+86 574 86685171, E-mail address:***linzhengde@nimte.ac.cn,**

*Tel: +86 574 87615701, E-mail address: **jiangnan@nimte.ac.cn*;**

SUPPLEMENT

The microtopography and Raman spectrogram of CVD SiC nanowires and the graphene are shown in **Figure S1**, respectively.

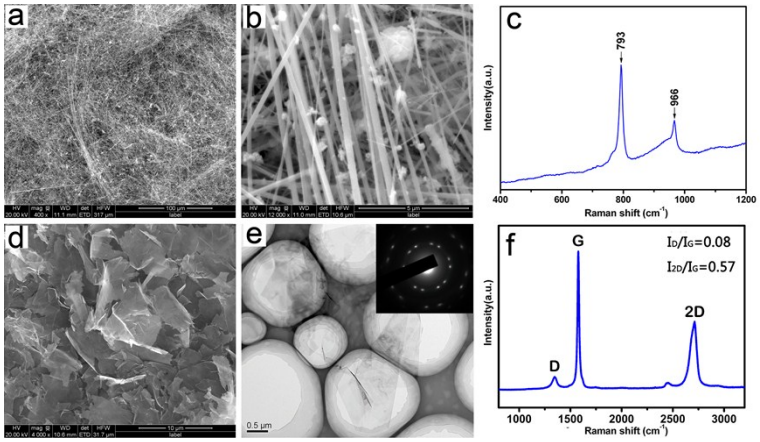

Figure S1. (a) The low magnification SEM image, (b) the hign magnification SEM image, and (c) the Raman spectrogram of the CVD SiC nanowires; (d) the SEM image, (e) the TEM image, and (f) the Raman spectrogram of GSs.

The schematic mechanism for preparing the 3DSG (presented in **Figure S2)** contributes us to understanding the synthetic process of SiC nanowires. As temperatures rise, the Si and SiO powder would react as follows:

$$2Si\ (s) + SiO_2\ (s) = 2SiO\ (v);$$

Then, the gaseous SiO reacted with the graphene to granrate SiC and SiO_2:

$$3SiO\ (v) + 3C\ (s) = 2SiC\ (s) + SiO_2\ (l) + CO\ (v);$$

The as-grown SiC was the crystalline nucleus for growth of nanowires, and the SiO_2 was in the melting state in high temperature. The next was the process of growth, when the following reaction occured:

$$3SiO\ (v) + CO\ (v) = SiC\ (s) + 2SiO_2\ (l);$$

The nanowires coming from the different GSs may contact, as them grew longer. In this stage, the

SiC core got in touch with others, and wrapped with molten SiO_2 shell. The molten SiO_2 began to freeze, as the temperature is lowered, which make different nanowires to combine strong. Finally, the GSs join together into cross-linked network through the combination of SiC nanowires.

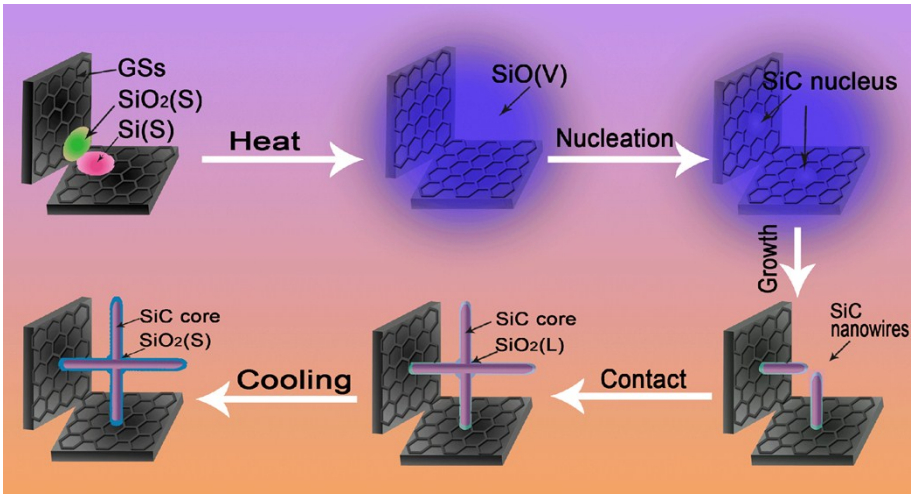

Figure S2. Schematic growth mechanism for the prepared 3DSG.

Figure S3 (a) illustrates the typical TGA curves of neat PI and PI composites in air. It's important to note that there is a synergistic effect in improving the thermal stability of PI matrix by hybrid 1D-2D filler. The $T_{d\text{-}5wt\%}$ of PI composites with the sole filler goes a little lower than the neat PI, because of the heavy agglomeration of filler in PI matrix. When the filler hybridirzed of SiC nanowires and GSs was adopted, the $T_{d\text{-}5wt\%}$ value achieved 531.4 °C, with the increases by 16.8 °C. It could be attributed to the assisted dispersion of the 1D-2D filler. However, the dispersion of 3DSG was not as good as the control group. The increase of thermal stability can be ascribed its good heat-conducting property to transfer heat and avoid heat concentrated. In addition, the thermal stability of neat PI and PI composites in nitrogen has been investigated by TGA, as shown in **Figure S3 (b)**. The 3DSG content in the polyimide composites has been calculated by TGA curves, which is noted to be 7.2, 9.3, and 11 wt%, respectively. One can see that the addition of 3DSG leads to the TGA curves to

shift toward higher temperatures slightly and that the higher loading of the 3DSG cannot bring on the further improvement of the thermal stability of PI composites.

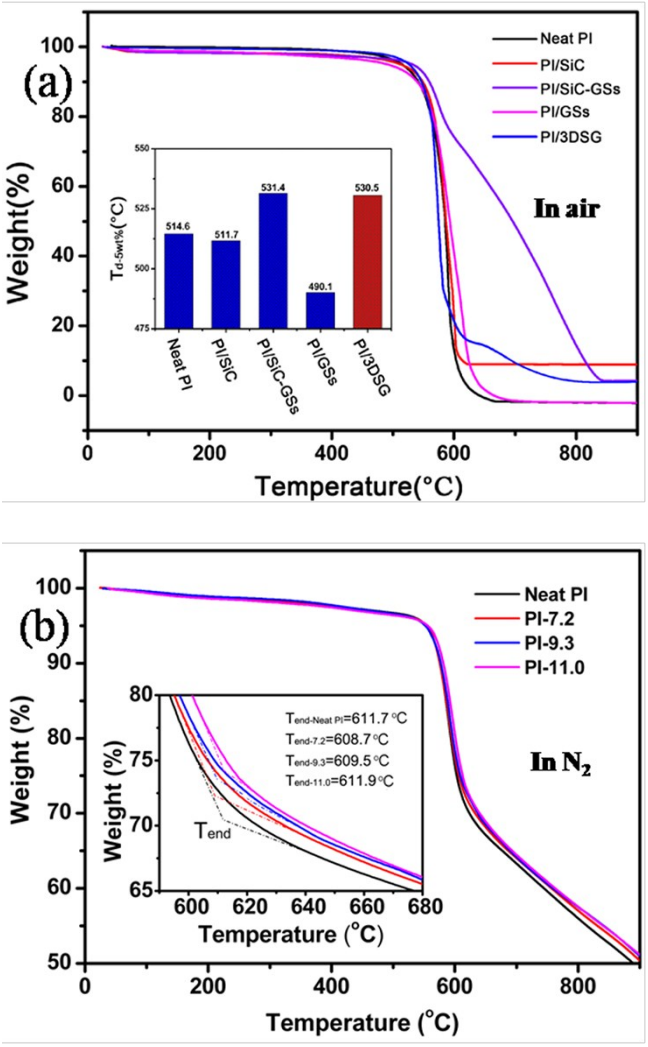

Figure S3. (a)The TGA curves of neat PI and PI composites in air, the inset is the $T_{d\text{-}5wt\%}$ (the 5 wt% decomposition temperature), (b) the TGA curves of neat PI and PI/3DSG composites with various contents in nitrogen, the inset is the T_{end} (the decomposition end temperature).