Supporting Information

Improving the mechanical properties and thermal conductivity of mesophase-pitch-based carbon fibers by controlling the temperature in industrial spinning equipment

Gaoming Ye[1,†], Kui Shi[1,†], Huang Wu[1], Dong Huang[1,2], Chong Ye[1,2,4,*], Ting Ouyang[1], Shi-peng Zhu[3,*], Zhen Fan[3], Hongbo Liu[1], Jinshui Liu[1,2,4*]

[1.] College of Materials Science and Engineering, Hunan Province Key Laboratory for Advanced Carbon Materials and Applied Technology, Hunan University, Changsha, 410082, PR China

[2.] Hunan Province Engineering Research Center for High Performance Pitch-based Carbon Materials, Hunan Toyi Carbon Material Technology Co., Ltd., Changsha, 410000, PR China

[3.] Key Laboratory of Advanced Functional Composite Materials, Aerospace Research Institute of Materials and Processing Technology, Beijing, 100076，PR China

[4.] State Key Laboratory of Advanced Design and Manufacturing for vehicle body, Hunan University, Changsha, 410082, PR China

**Corresponding author. YE Chong. E-mail: yec@hnu.edu.cn;*

ZHU Shi-peng. E-mail: carbonfiber703@163.com;

LIU Jin-shui. E-mail: Jsliu@hnu.edu.cn

Details of Experimental Section:

1. **The spinning state**

the spinning state became poor when the temperature was too high or too low (Fig. S1). When the temperature was lower than 309 ° C, the pitch fiber was easy to be pulled off due to its high viscosity and poor fluidity after flowing out of the spinneret hole (Fig. s1(a)). When the temperature is higher than 320.5 ° C (such as 322 ° C), the mesophase pitch adhered to the spinneret, resulting in more spinneret hole blockage and worse spinning state (Fig. s1(b)).

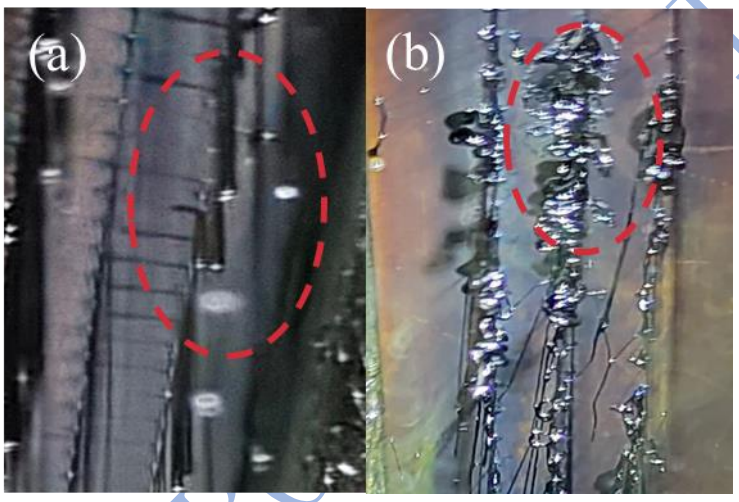

Fig. S1 Spinning state: (a) 307℃, (b) 322℃

2. The dynamic modulus test diagram

the dynamic modulus test diagram of 1-10HZ frequency in the temperature range of 300 ~ 320 °C (Fig. S2).At the same spinning temperature, the higher the frequency, the higher the dynamic modulus. At the same measure frequency, the higher the temperature, the higher the dynamic modulus. This means that at higher temperatures, the deformation resistance of mesophase pitch is poor and it is easier to flow and shear. The result is consistent with the viscosity test law (Fig. 2 (a)).

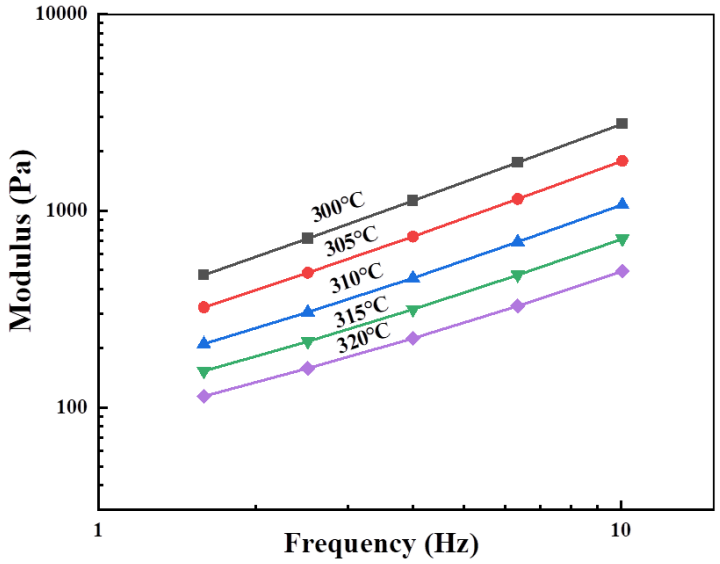

Fig. S2. Dynamic modulus test of mesophase asphalt.

3. **The splitting angle**

The splitting angle identified in Fig.5 is the average of 20 fibers (**Line 234**), and the statistical histogram of splitting angle is shown in **Fig.S3**.

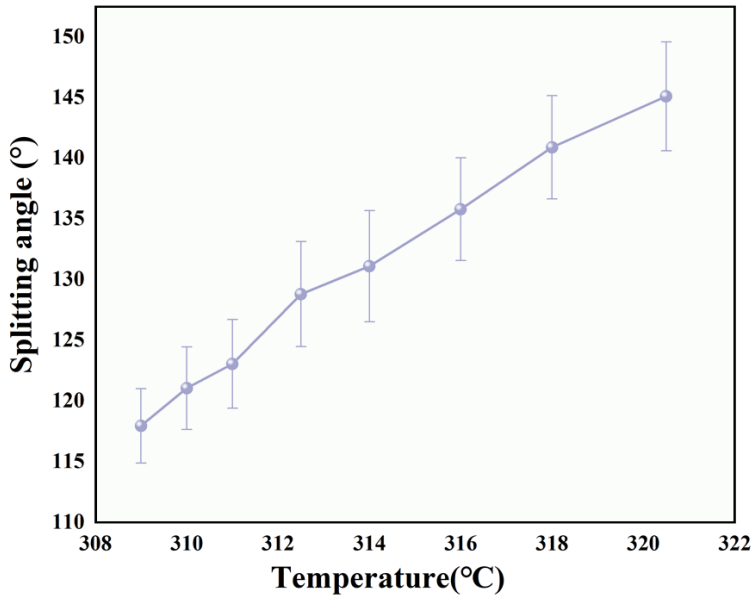

Fig.S3. the statistical histogram of splitting angle of 20 fibers

4. **Experimental data for die swelling**

In this paper, the constant discharge amount of spinneret hole is carried out by metering pump, ensure that the shear rate of the mesophase pitch is consistent, and measure the die swelling ratio at different temperatures. The die swell ratio is defined as B = D / d, where D is the diameter of the extrudate and d is the diameter of the spinneret hole. The average diameter D of 20 extrudates within 1 cm from the outlet of the spinneret hole was measured, d = 0.1 mm, the B were 1.45,1.33 and 1.21 at 309 °C, 314 °C and 320 °C **(Fig. S4)**, respectively. Therefore, it is concluded that the higher the temperature, the smaller the die swell.

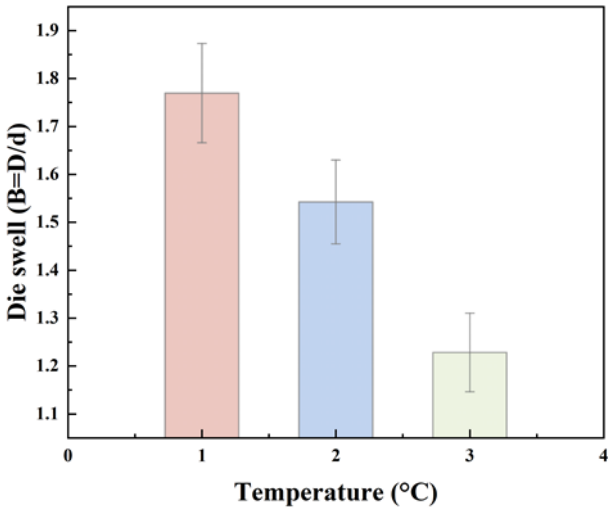

Fig.S4 Die swell:(1) 309 °C, (2) 314 °C, (2) 320.5 °C