Supplementary Materials

Estimation of σ_M

Owing that $\sigma^2_M = \sigma^2_{obj} + \sigma^2_{det}$, σ_{obj} and σ_{det} are calculated separately.

Firstly, the edge between CF and PG is considered gradient in a projection. Because the carbon fibers are cylinders with a diameter of 6μm, the spread width of the step signal is set to 3μm. The phase shift distribution is given in Fig. S1(a), while a profile of a line in Fig. S1(a) is shown in Fig. S1(b). Then, the derivative of the phase shift function in Fig. S1(b) is calculated as the blue curve in Fig. S1(c). Finally, Gauss fitting is conducted as the red curve in Fig. S1(c). The fitting function is

$$y = 0.006 + (\sqrt{2\pi}\cdot 0.110)^{-1} \exp[-(x-3.104)^2 / (2\cdot 0.110^2)],\ R^2=0.754.$$

Thus σ_{obj} is 0.110μm.

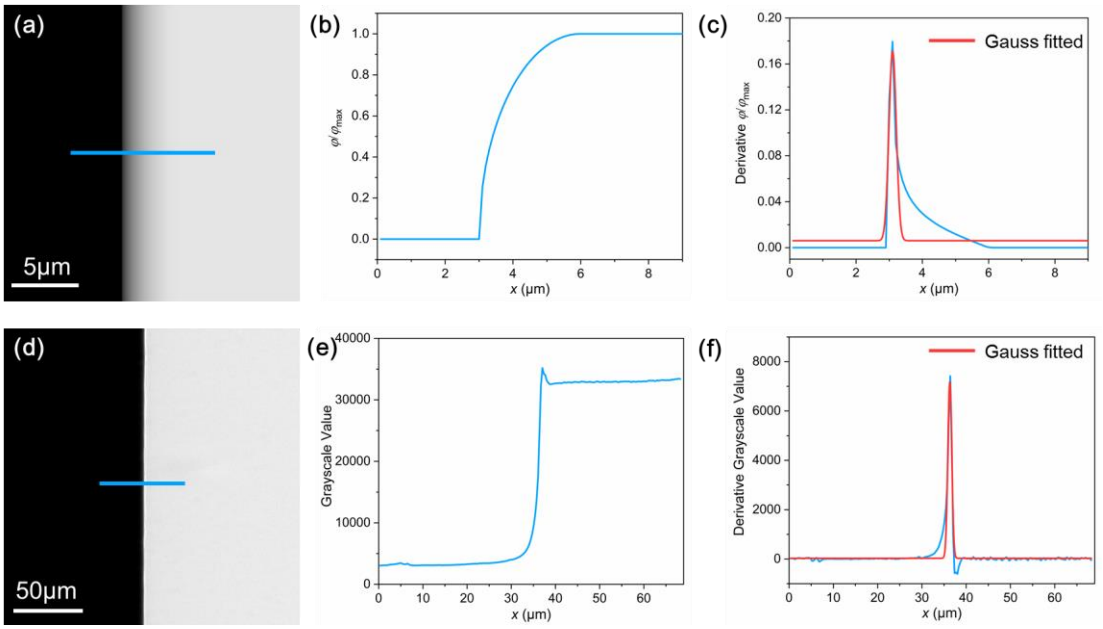

Fig. S1 Estimation of σ_{obj} and σ_{det}, where (a) phase shift distribution near the CF/PG edge, (b) profile of a line in (a), (c) derivative of (b) (blue curve) and its Gauss fitted (red curve), (d) projection of a slit on the detector, (e) profile of a line in (d), (f) derivative of (e) (blue curve) and its Gauss fitting (red curve).

The point spread function of the detector was tested using a slight edge of a slit. This slit is placed right in front of the detector as close as possible to reduce the effect of diffraction of the edge. The projection of this slit is given in Fig. S1(d). The profile of a line in Fig. S1(d) is shown in Fig. S1(e), which is the edge spread function. Therefore, the point spread function is the derivative of Fig. S1(e) which is the blue curve in Fig. S1(f). After the fitting of Gauss function, the resulting function is

$$y = 28.909 + (\sqrt{2\pi}\cdot 0.441)^{-1} \exp[-(x-36.301)^2 / (2\cdot 0.441^2)],\ R^2=0.927.$$

So, the σ_{det} is 0.441μm.

Finally, $\sigma^2_M = \sigma^2_{obj} + \sigma^2_{det}$, σ_M =0.454μm.

SEM slice observation

Owing that the spatial resolution of in-line PCMT is about 0.98μm, pores whose diameter is under 1.0μm cannot be detected, therefore, a SEM slice observation of the composite was conducted to verify the existence of these tiny pores. The SEM system is from Zeiss Company and its mode is Merlin Compact. Results are as follows.

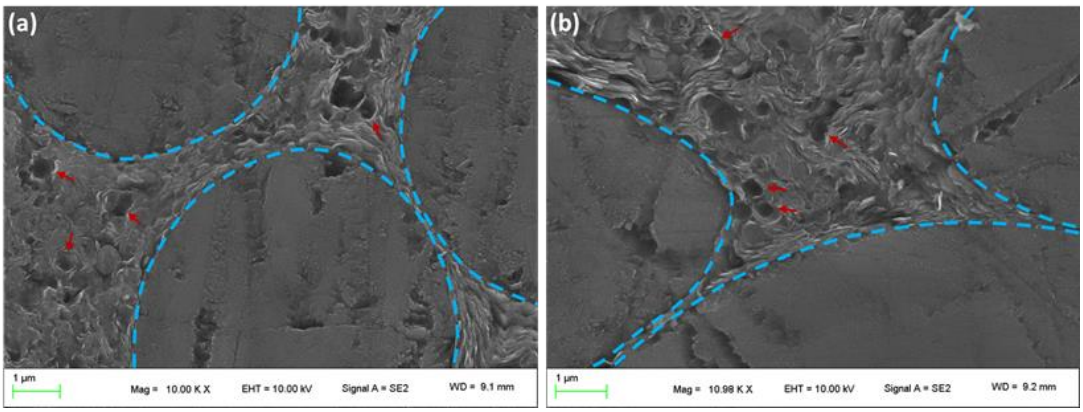

Fig. S2 SEM slice observation of the CF/PG composite, where blue dashed curves depict the boundaries between CF and PG, while red arrows mark the isolated pores whose diameter is less than 1μm.