Supplementary Materials: MWCNT–Polyimide Fiber-Reinforced Composite for High-Temperature Tribological Applications

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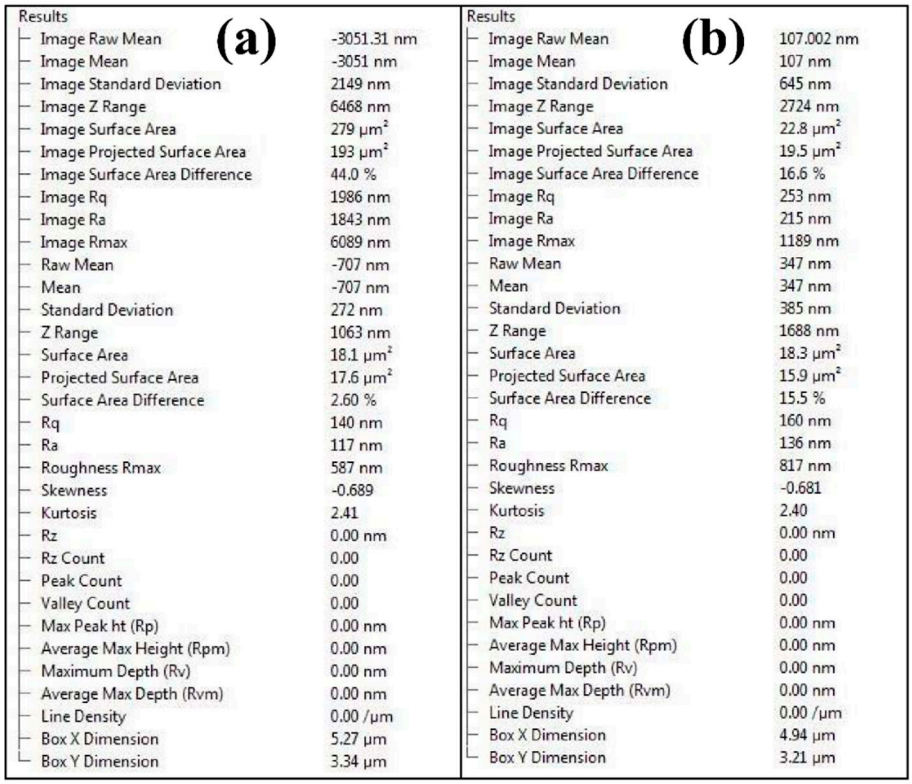

Results	(a)	(b)
Image Raw Mean	-3051.31 nm	107.002 nm
Image Mean	-3051 nm	107 nm
Image Standard Deviation	2149 nm	645 nm
Image Z Range	6468 nm	2724 nm
Image Surface Area	279 μm²	22.8 μm²
Image Projected Surface Area	193 μm²	19.5 μm²
Image Surface Area Difference	44.0 %	16.6 %
Image Rq	1986 nm	253 nm
Image Ra	1843 nm	215 nm
Image Rmax	6089 nm	1189 nm
Raw Mean	-707 nm	347 nm
Mean	-707 nm	347 nm
Standard Deviation	272 nm	385 nm
Z Range	1063 nm	1688 nm
Surface Area	18.1 μm²	18.3 μm²
Projected Surface Area	17.6 μm²	15.9 μm²
Surface Area Difference	2.60 %	15.5 %
Rq	140 nm	160 nm
Ra	117 nm	136 nm
Roughness Rmax	587 nm	817 nm
Skewness	-0.689	-0.681
Kurtosis	2.41	2.40
Rz	0.00 nm	0.00 nm
Rz Count	0.00	0.00
Peak Count	0.00	0.00
Valley Count	0.00	0.00
Max Peak ht (Rp)	0.00 nm	0.00 nm
Average Max Height (Rpm)	0.00 nm	0.00 nm
Maximum Depth (Rv)	0.00 nm	0.00 nm
Average Max Depth (Rvm)	0.00 nm	0.00 nm
Line Density	0.00 /μm	0.00 /μm
Box X Dimension	5.27 μm	4.94 μm
Box Y Dimension	3.34 μm	3.21 μm

Figure S1. The roughness of PI fiber (**a**) before and (**b**) after MWCNTs decorations.

Table S1. Thermal data obtained TGA analyses of composites.

Materials	T_5 (℃)	R_w (%)	Density (g/cm^3)
TPI	568.2	54.4	1.357
TPI+PIF	574.1	57.6	1.384
TPI+PIF-NWCNTs	582.7	61.7	1.419

（T_5: The temperature at 5% material mass loss; *R*esidual mass fraction of the material at 750°C）.

Table S2. COF and wear rate of the PI samples at room temperature and 300°C conducted at 0.5m/s and 10N.

Materials	COF		Wear rates（$10^{-6}mm^3/Nm$)	
	RT	300℃	RT	300℃
PI	0.301±0.0294	0.407±0.0332	6.93±0.53	23.92±2.13
PI/PIF	0.321±0.0303	0.424±0.0198	4.87±0.48	16.72±2.11
PI/PIF-MWCNTs	0.297±0.0125	0.399±0.0329	3.92±0.55	15.66±1.87

Table S3. COF and wear rate of PI/PIF-MWCNTs composite with varied sliding speeds and normal loads.

Parameter	COF	Wear rates（$10^{-6}mm^3/Nm$)
2N, 0.5m/s	0.270±0.0042	1.20±0.14
5N, 0.5m/s	0.288±0.0031	2.14±0.18
10N, 0.5m/s	0.297±0.0125	3.92±0.55
10N, 0.75m/s	0.298±0.0090	5.48±0.36
10N, 1.0m/s	0.302±0.0031	7.19±0.64