

Supporting Information

Covalently-Linked Hexagonal Boron Nitride-Graphene Oxide Nanocomposites as High-Performance Oil-Dispersible Lubricant Additives

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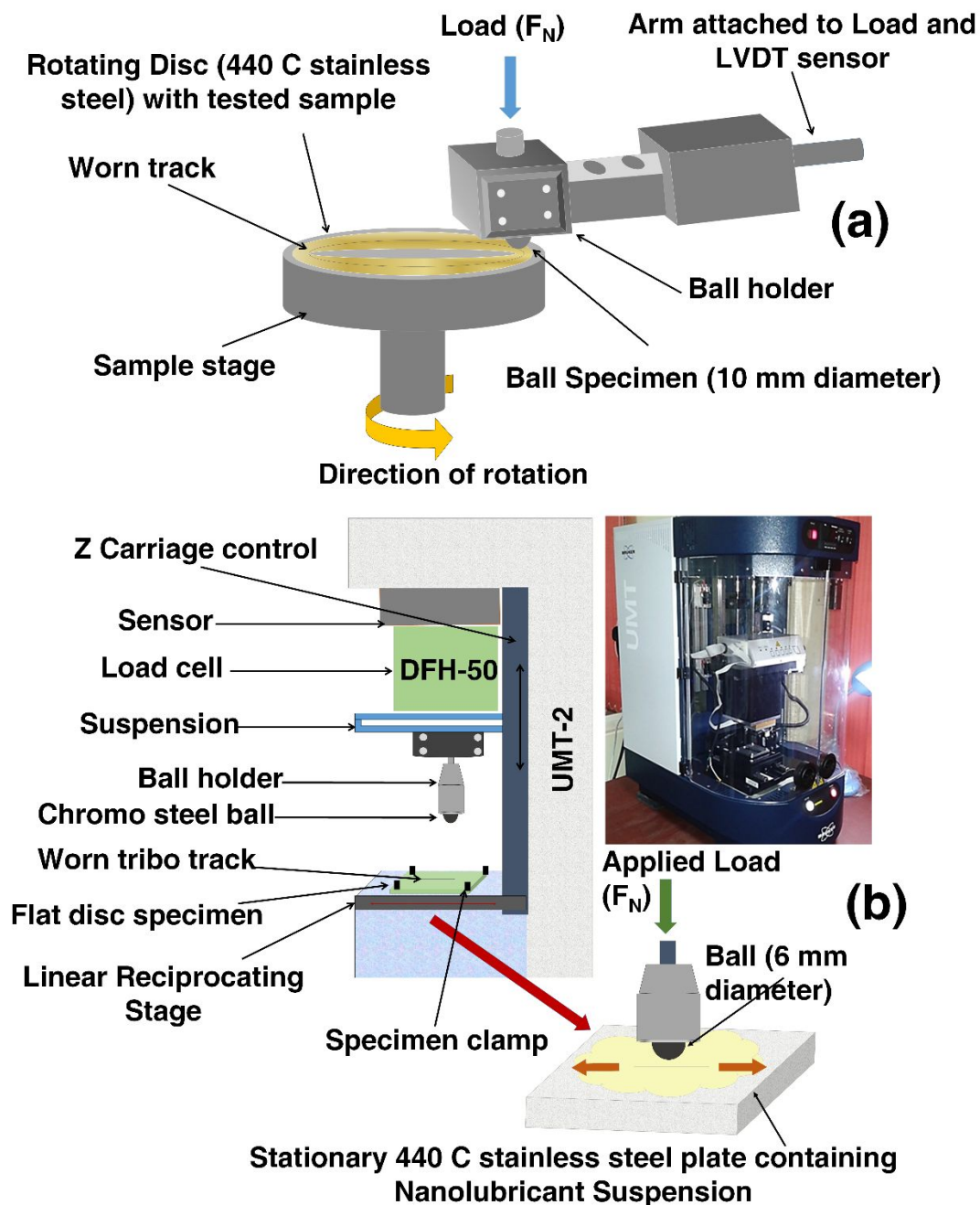


Fig S1: (a) Schematic illustration for macrotribological experimental set up, (b) Schematic and photographic representations for microtribological experimental set up during rotating/reciprocating sliding with h-BN and its functionalized parts as lubricant additives.

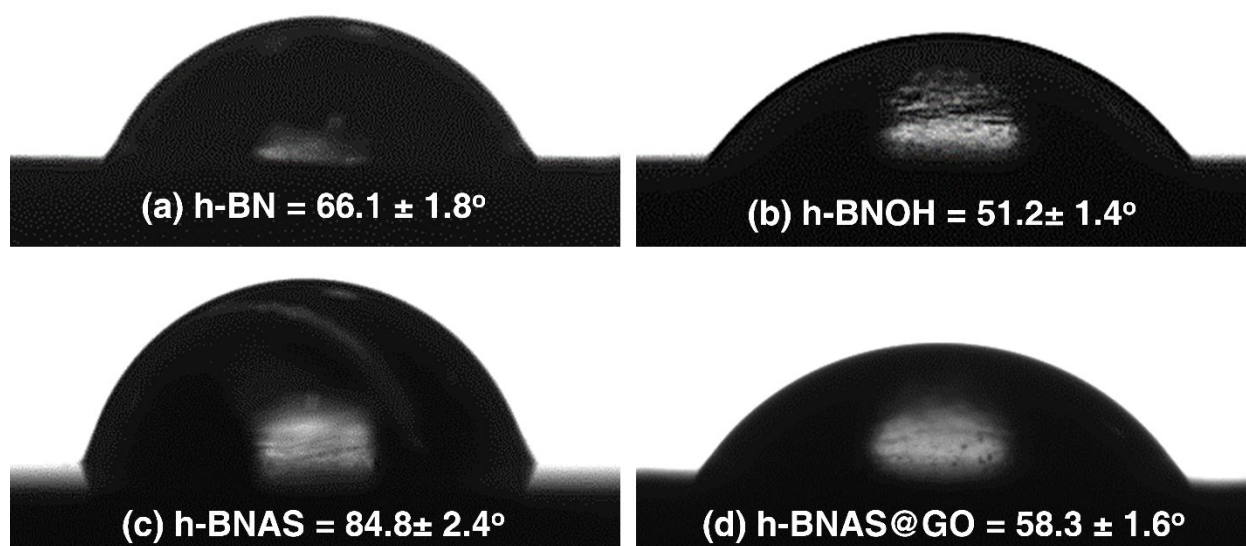


Fig S2: Water contact angle measurements on (a) h-BN, (b) h-BNOH, (c) h-BNAS and (d) h-BNAS@GO particle pallet with corresponding contact angle values.

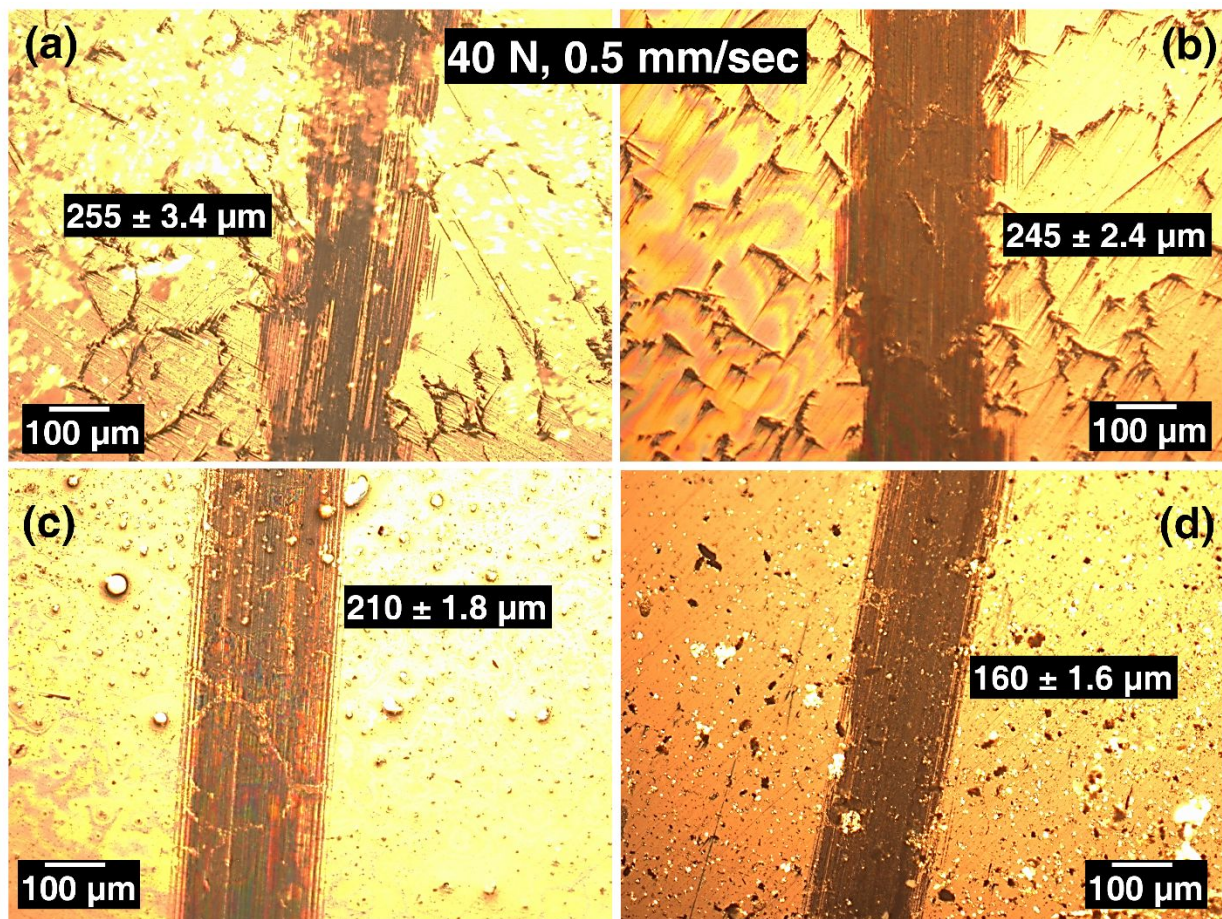


Fig S3: Posttribological optical microscope images and corresponding tribo track width generated with microtribological ball-on-disc experiments (40 N, $P_m \sim 2.15$ GPa) on disc surfaces for (a) h-BN, (b) h-BN-OH, (c) h-BNAS and (d) h-BNAS@GO composite dispersed nanolubricant at HLLS conditions using sliding stroke length of 5 mm.

Table S1: Properties of base lubricating (heavy paraffin) oil

Property	Value with units
Colour	Colourless
Density at 20 °C	0.85 g/cm ³
kinematic viscosity 40 °C	66.0 cSt
Flash point	>210 °C
Pour point	- 15 °C
Decomposition temperature	> 350 °C
Ignition temperature	> 300 °C
Boiling point range	300 °C – 400 °C

Table S2: The condition for the macrotribological experiments.

Test conditions	Parameters
Geometry	Ball-on-disc (face loaded, rotating)
Type of contact	Point
Applied normal load	30 N ($P_m = 1.4$ GPa), 50 N ($P_m = 1.67$ GPa) and 80 N ($P_m = 1.95$ GPa).
Rotating sliding speed	0.4 m/s
Duration of the sliding	60 min
Nature of the disc samples	440 C stainless steel [hardness (HV) = 510, elastic modules = 193 GPa, Poisson's ratio = 0.27, RMS roughness ~ 5 nm]
Counter parts	10 mm diameter chrome steel ball
Sliding condition	Oil lubricated sliding, $T \sim 25$ °C, relative humidity ~ 32%-47%.
Lubricant	Functionalized nanoparticles suspended in heavy paraffin oil.

Table S3: Microtribological experimental conditions.

Test conditions	Parameters
Geometry	Ball-on-disc (face loaded, Precision-Positioning Slow-Reciprocating Linear Drive)
Type of contact	Point
Applied normal load	Low Load (LL): 10 N ($P_m = 1.36$ GPa) and High Load (HL): 40 N ($P_m = 2.15$ GPa).
Stokes Length	5 mm
Reciprocating sliding speed	Low Speed (LS): 0.5 mm/sec) and High Speed (HS): 5 mm/sec
Property of the sliding substrate	440 C stainless steel [hardness (HV) = 510, elastic modules = 193 GPa, Poisson's ratio = 0.27, RMS roughness ~ 5 nm]
Counter parts	6 mm diameter chrome steel ball
Sliding condition	Oil lubricated sliding, $T \sim 25$ °C, relative humidity $\sim 32\%$ -47%.
Lubricant	Functionalized nanoparticles suspended in heavy paraffin oil.

Table S4: Elemental wt% from EDS analysis in tribo track surfaces from microtribological ball loading tests for h-BN, h-BN-OH, h-BNAS and h-BNAS@GO composite at 40 N ($P_m \sim 2.15$ GPa) load and LS condition.

Lubricant particles	Element (wt%)				
	C	B	O	Si	Fe
h-BN	18.59± 1.78	13.25±1.12	6.53± 0.78	--	61.63± 3.25
h-BNOH	15.07± 1.23	12.89±1.09	11.78± 1.18	--	60.26± 2.98
h-BNAS	22.45± 2.12	18.49±1.86	5.46± 0.62	2.34± 0.32	51.26± 2.76
h-BNAS@GO	33.46± 2.98	18.22± 2.13	4.56± 0.45	1.98± 0.23	41.78± 2.18