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I, Sooraj Singh Rawat, certify that the work embodied in this thesis is my own bona fide work and carried out by me under the supervisions of Prof. A. P. Harsha and Dr. O. P. Khatri from December 2015 to July 2021, at the Department of Mechanical Engineering, Indian Institute of Technology (BHU), Varanasi. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma. I declare that I have faithfully acknowledged and given credits to the research workers wherever their works have been cited in my work in this thesis. I further declare that I have not willfully copied any other's work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports dissertations, theses, etc., or available at websites and have not included them in this thesis and have not cited as my own work.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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(Sooraj Singh Rawat)

Dedicated to
my beloved parents

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Abbreviations/symbols

Abbreviation/Symbol	Description
AF	Antifriction
AFM	Atomic force microscopy
AISI	American Iron and Steel Institute
Al	Aluminum
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
AW	Antiwear
at%	Atomic percentage
BAC	Bearing area ratio curve
C	Carbon
Ca	Calcium
Cl	Chlorine
CO_2	Carbon dioxide
COF	Coefficient of friction
cm	Centimeter
^oC	Degree centigrade
d	Diameter
d	Interlamellar spacing
deg	Degree
E	Young's modulus
EDS	Energy dispersive spectroscopy
EHL	Electrohydrodynamic lubrication

EP	Extreme pressure
eV	Electron volt
Fe	Iron
FM	Friction modifier
FTIR	Fourier transform infrared
g	Gram
$\dot{\gamma}$	Shear rate
G’	Storage modulus
G”	Loss modulus
GO	Graphene oxide
GO–ODA	Chemically functionalized graphene oxide with long–chain octadecylamine
GPa	Giga pascal
h	Hour
H	Hydrogen
Hz	Frequency
H_2SO_4	Sulfuric acid
HCl	Hydrochloric acid
JCPDS	Joint Committee on Powder Diffraction Standards
k	Consistency factor
k	Wear coefficient
KBr	Potassium bromide
kg	Kilogram
kgf	Kilogram force
$KMnO_4$	Potassium permanganate

kV	Kilovoltage
l	Length
Li	Lithium
LWI	Load wear index
λ	Wavelength of incident X–ray radiation
λ	Film thickness parameter
m	Meter
mA	Milliampere
mm	Millimeter
µL	Microliter
µm	Micrometer
µ	Coefficient of friction
min	Minute
MJ	Mega joule
MoS_2	Molybdenum disulfide
MoS_2–ODT	Chemically functionalized molybdenum disulfide with long–chain octadecanethiol
MWV	Mean wear volume
n	Shear thinning index
N	Nitrogen
η	Apparent viscosity
Na	Sodium
$NaNO_3$	Sodium nitrate
NLGI	National Lubricating Grease Institute
nm	Nanometer

O	Oxygen
ODA	Octadecylamine
ODT	1–octadecanethiol
OPEC	Organization of the Petroleum Exporting Coundtries
P	Phosphorus
P	Cone penetration by test method D 217
p’	Cone penetration by ½ scale
p”	cone penetration by ¼ scale
%	Percentage
P_{max}	Maximum contact pressure
pH	Potential of hydrogen
PAO	Polyalphaolefines
PTFE	Polytetrafluoroethylene
ϕ	Diameter
R	Radius of steel ball before test
R	Correlation coefficient
R_a	Average line roughness
R_q	Root–mean–square line roughness
rGO	Reduced graphene oxide
rpm	Revolutions per minute
υ	Poisson’s ratio
s	Second
S	Sulphur
S_a	Average surface roughness
Si	Silica

S_k	Core roughness depth
S_{ku}	Kurtosis
S_{pk}	Reduced peak height
S_q	Root–mean–square surface roughness
S_{r1}	Peak material component
S_{r2}	Valley material component
S_{sk}	Skewness
S_{vk}	Reduced valley depth
SAOS	Small–amplitude oscillatory shear
SEM	Scanning electron microscope
SiO_2	Silicon dioxide
SPM	Scanning probe microscope
SRV	Schwingung reibung verschleiss (German)
	Oscillating, friction, wear, (English translation)
SWR	Specific wear rate
T_{onset}	Onset temperature
T_{max}	Maximum decomposition temperature
t	Thickness
τ	Shear stress
τ_y	Yield shear stress
TEM	Transmission electron microscope
TEOS	Tetraethoxysilane
TGA	Thermogravimetric analysis
TXP	Trixylyl phosphate
θ	Incident angle

VI	Viscosity index
W_q	Planimetric wear
W_V	Total wear volume
WR	Wear rate
WS_2	Tungsten disulfide
WSD	Wear scar diameter
wt%	Weight percentage
% w/v	Weight by volume percentage
% w/w	Weight by weight percentage
WTW	Wear track width
WV	Wear volume
XPS	X–ray photoelectron spectroscopy
XRD	X–ray diffractometer
ZDDP	Dialkyldithiophosphate
2D	Two–dimensional
3D	Three–dimensional
↑	Increase
↓	Decrease