

Supplementary

1. Characterization of Sample S3

Since the only difference between S2 and S3 was that they were prepared under different temperature, their characterization results were similar. The UV-vis of sample S3 was shown in Figure S1. The tribological characterization results of S3 were shown in Table S1 and Figure S2. The EDS spectra of sample S3 was shown in Figure S3.

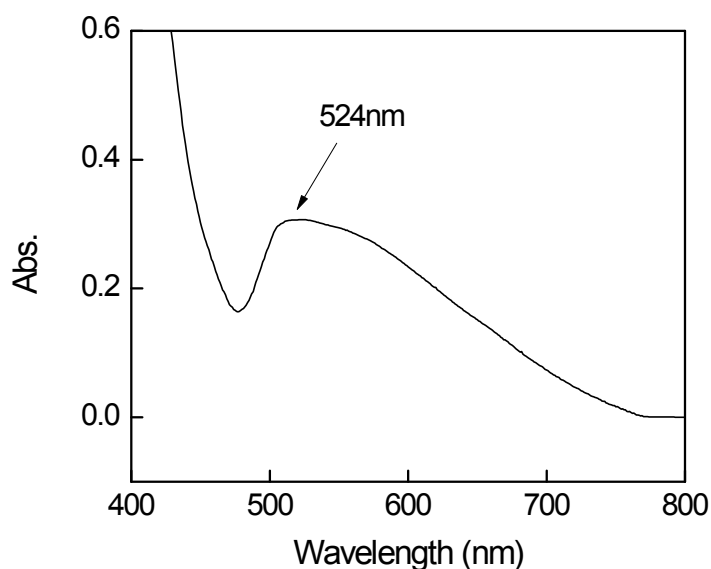


Figure S1 The UV-vis absorption spectra of sample S3.

Table S1. Mean friction coefficient of nanolubricants S3 and the wear scar diameter of steel balls lubricated by S3.

Characterization results	Value	Standard deviation
Mean friction coefficient	0.058	0.000984
Wear scar diameter (nm)	0.354	0.000720

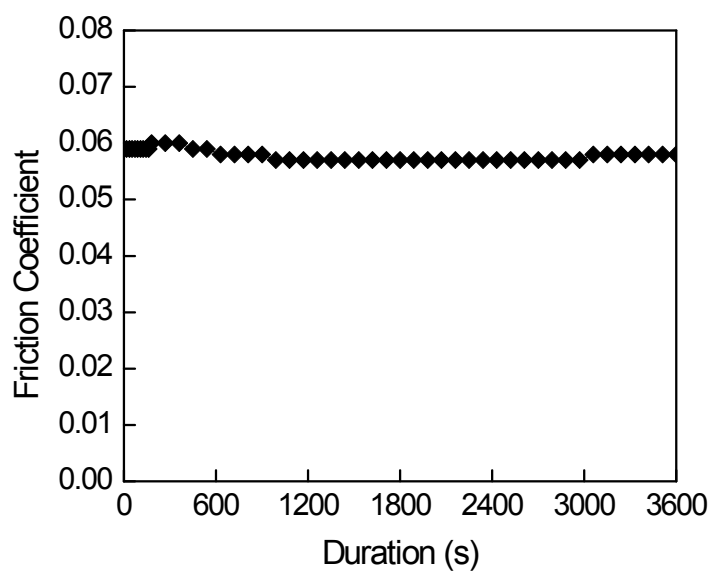


Figure S2 Friction coefficient of nanolubricants S3 under 392N of load.

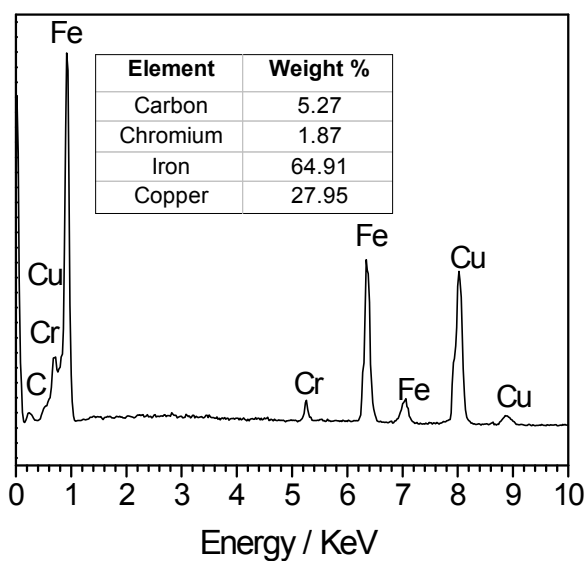


Figure S3 EDS spectrum of the worn surface lubricated by nanolubricant S3.

2. Stability of nanolubricant

The particle size and friction coefficient measurement of nanolubricant after 6 months of storage at ambient condition were shown in Table S2 and Figure S4, respectively.

Table S2. The average size of nanolubricant S1 after 6 months of storage at the ambient temperature

Sample	Average diameter	Standard deviation
S1 after 6 months	8.11	0.27195

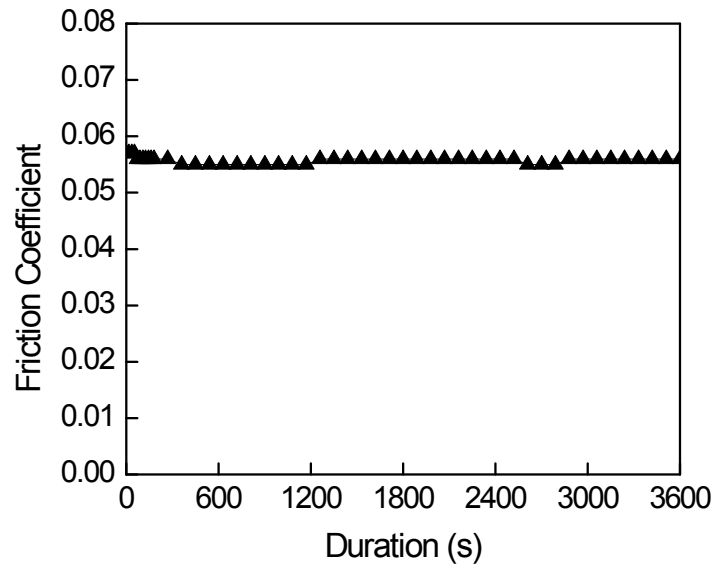


Figure S4 Friction coefficient of S3 after 6 months of storage under 392N of load.

3. Measurement and calculation method of wear scar diameter

The wear scar diameter was measured by a modified measuring microscope installed in the four-ball tribotester. During the process, both the longitudinal and the horizontal wear scar diameter were measured and the average of the two diameters was noted as the average wear scar diameter for each ball. Similar method was used to obtain the average wear scar diameter of the other two balls. The average value of three balls was defined as the final wear scar diameter. A representative wear scar image (lubricated by sample S1) was shown in Figure S5.

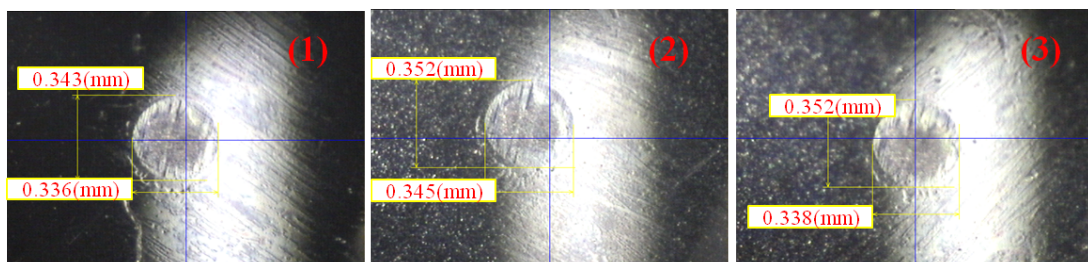


Figure S5 Wear scar diameters of three steel balls lubricated by sample S1.