

# X-ray absorption spectroscopy of tribofilm produced from Mg/Al- $\text{CO}_3^{2-}$ -LDH on steel

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# Background

- *Inorganic nano/microscale particles as lubricant components:*

Layered inorganic mineral powders have gained an increasing interest as extreme pressure and anti-wear additives for liquid lubricants. In general the efficacies of the additives are considered as chemically or mechanically producing a depositing film (SEM/XRF/EDS-topography, elements, elemental distribution) on the contacting surfaces. The difficulties in characterizing the films are due to the fact that they are extremely thin; and also that conventional analytical methods are not sensitive enough to allow chemical speciation.

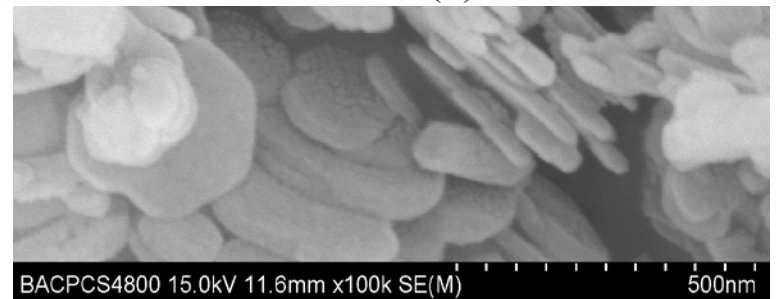
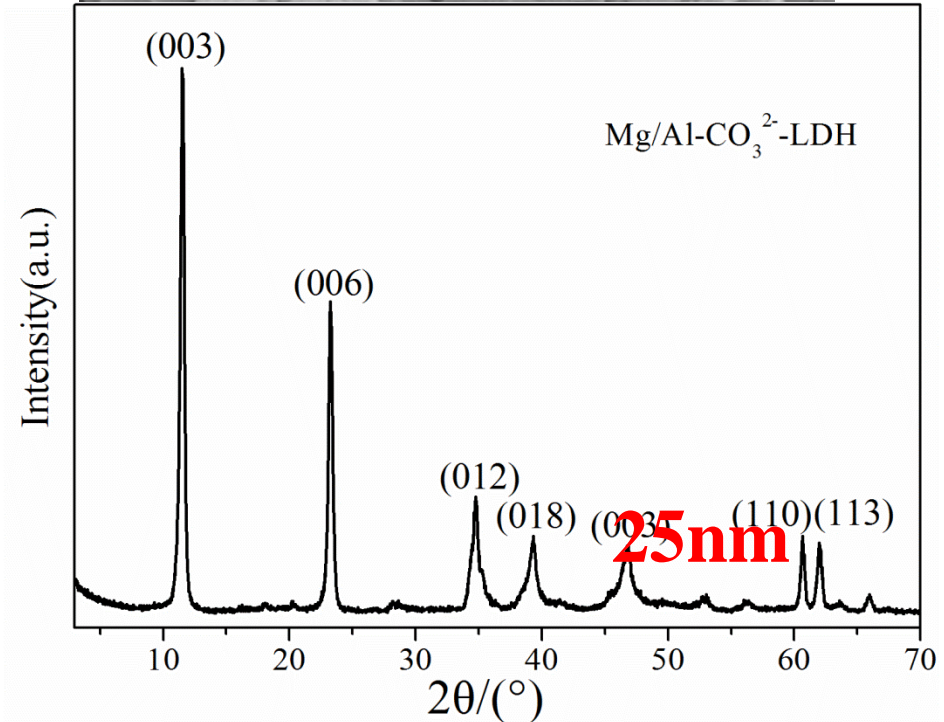
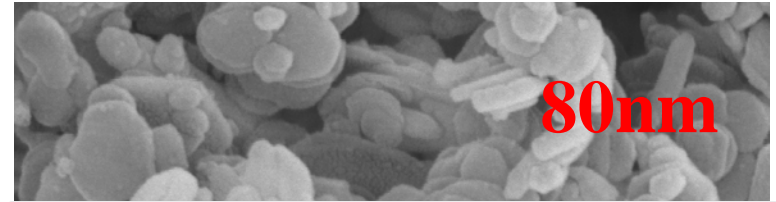
- *X-ray absorption spectroscopy:*

It is able to give elemental composition, oxidation state information, local geometry information of the absorbing atom. It also has the chemical sensitivity for complex nonconducting samples, measuring surface and bulk chemical environments and chemical speciation.

# Mg/Al-CO<sub>3</sub><sup>2-</sup>-LDH(MAC-LDH)

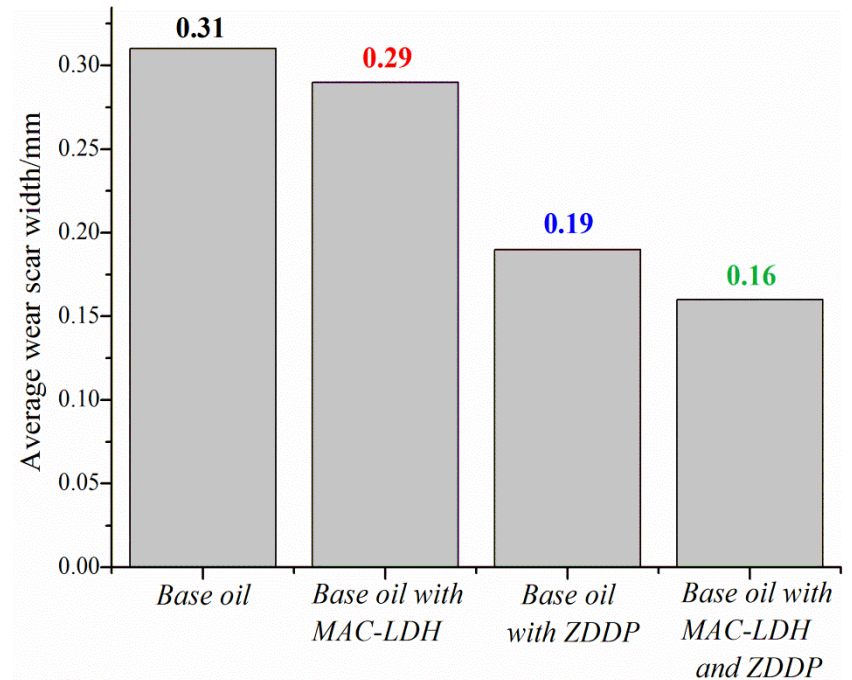
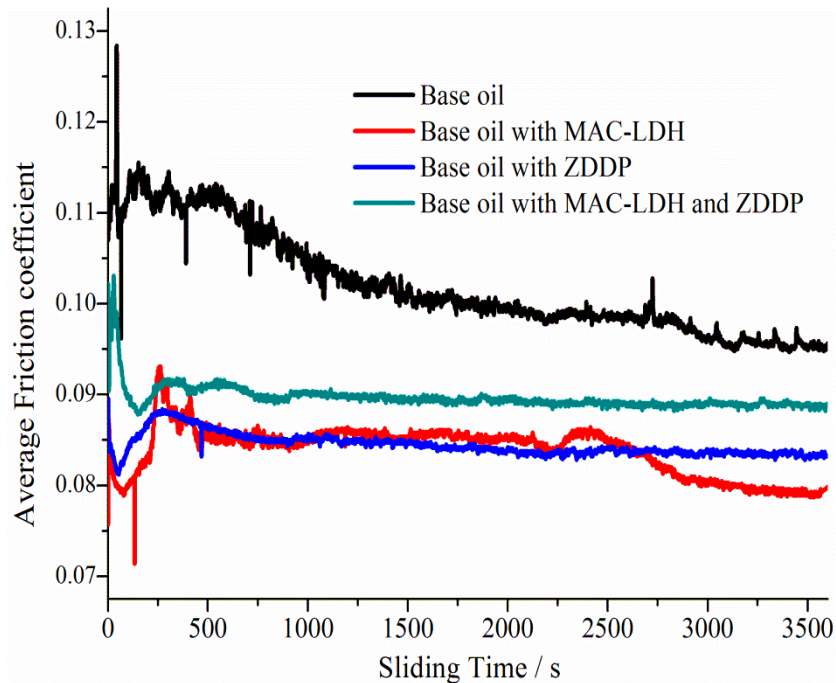
## *Preparation of MAC-LDH:*

- Hydrothermal method
- Mg(NO<sub>3</sub>)<sub>2</sub> and Al(OH)<sub>3</sub> (Mg/Al = 2:1)
- Add base NaOH + Na<sub>2</sub>CO<sub>3</sub>
- Crystallization/ageing at 110 °C for 12 h
- Wash
- Dry at 70 °C for 12h

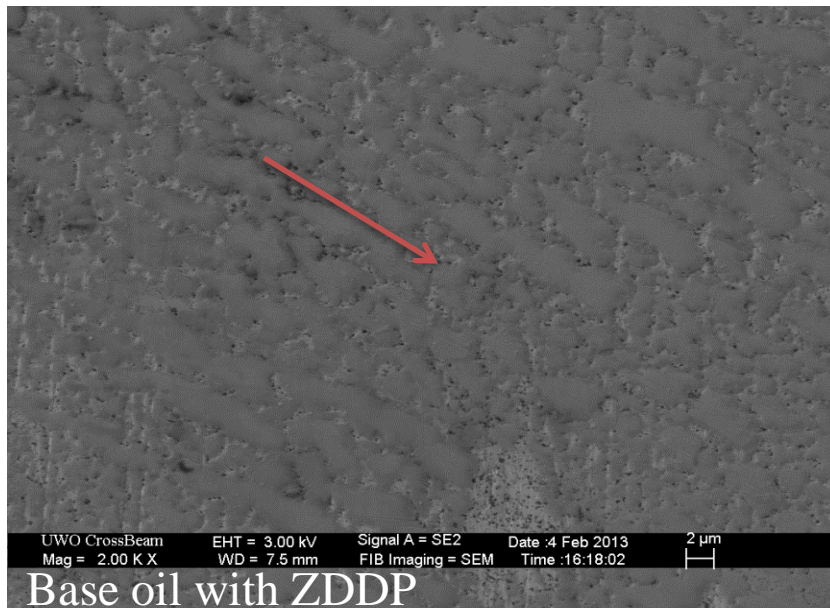


# Tribological performances

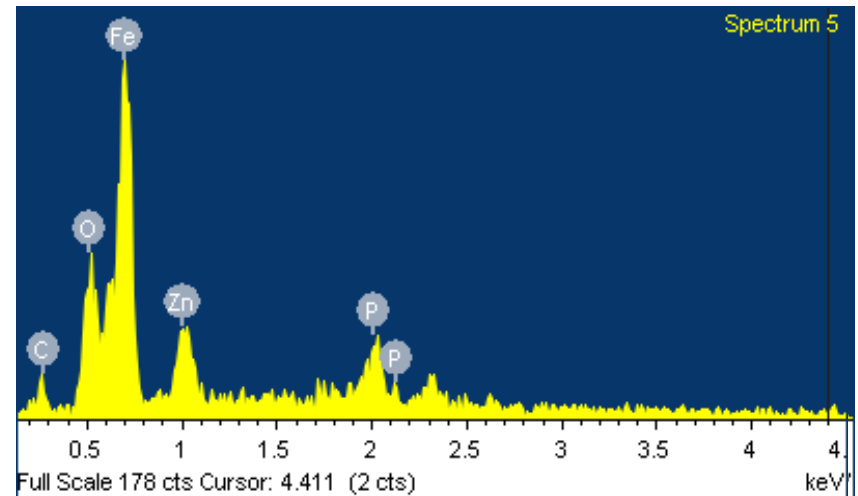
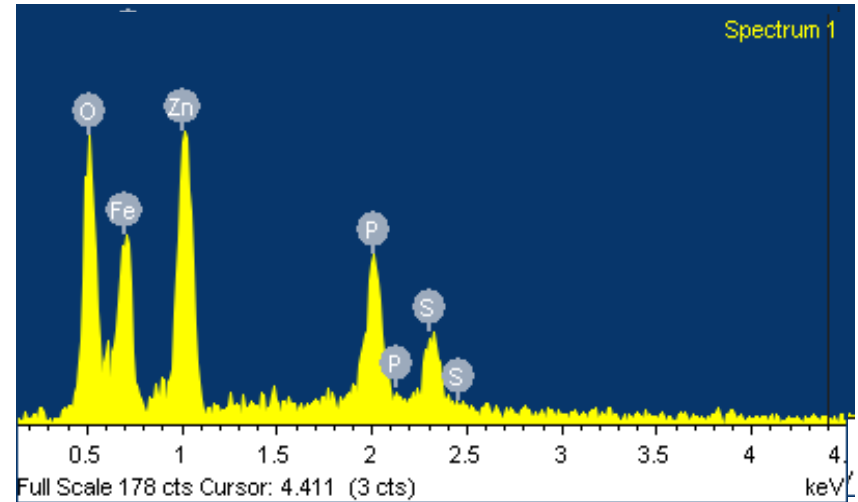
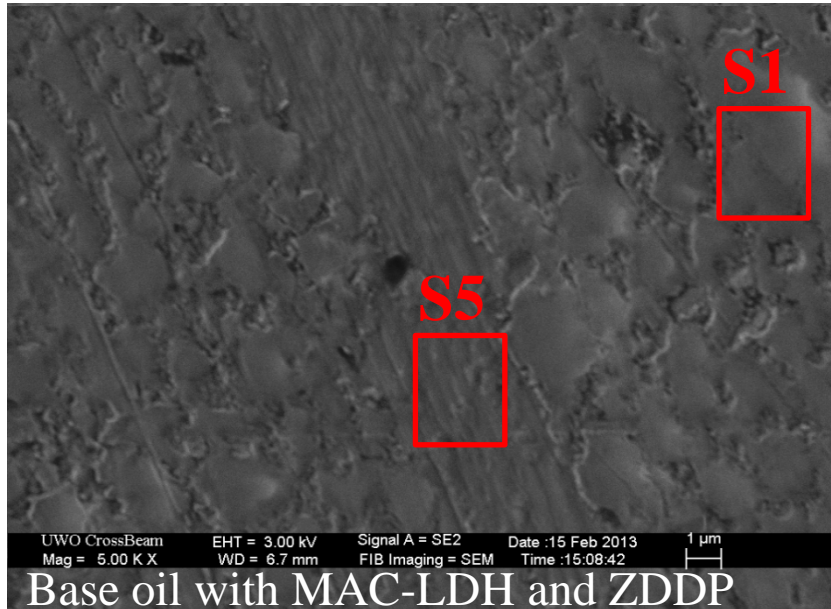
220N, 25Hz, 100°C, 1h



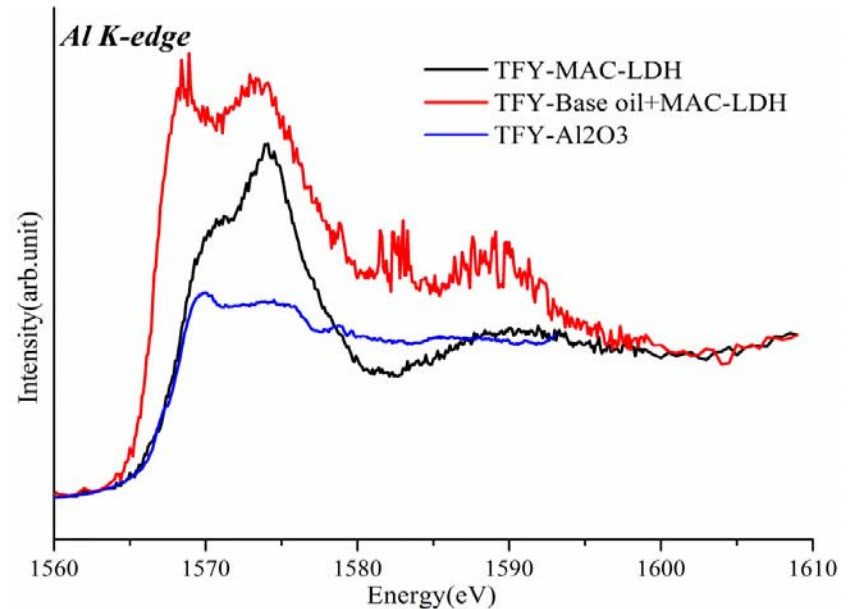
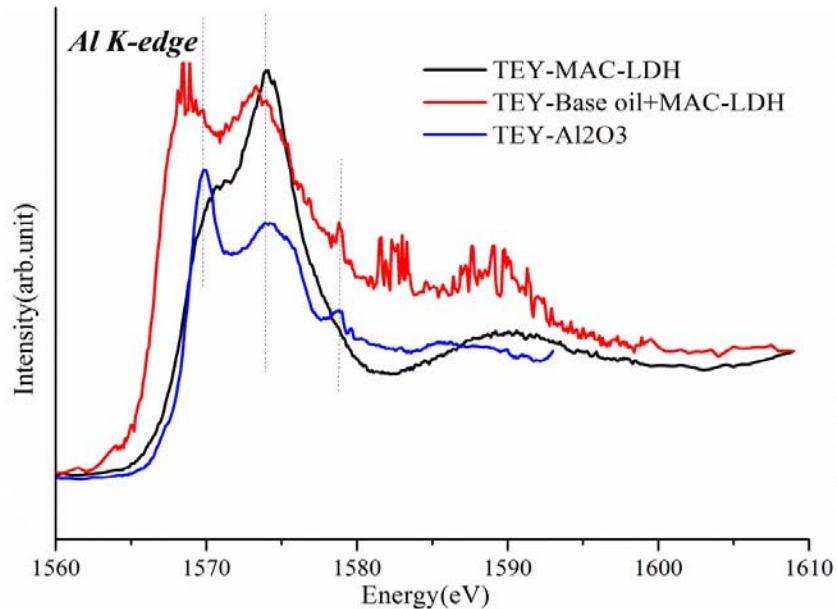
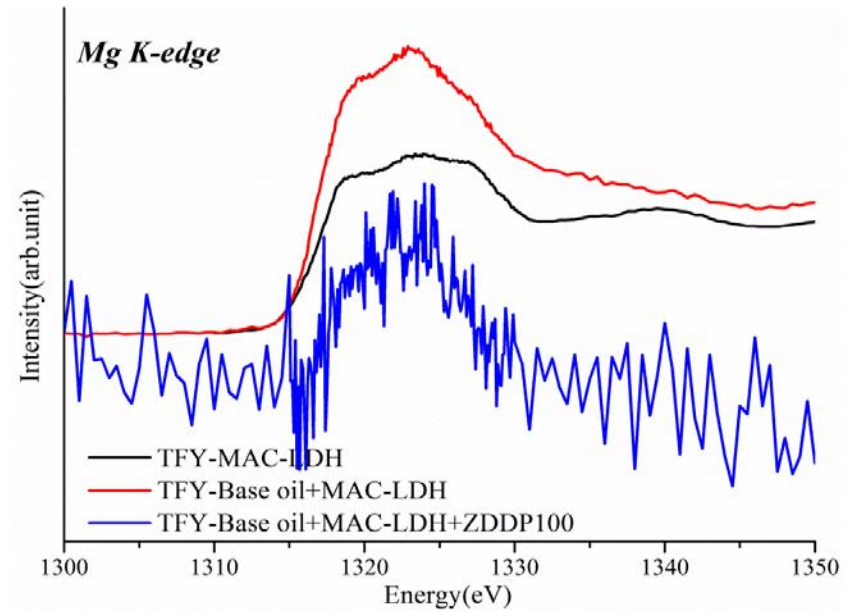
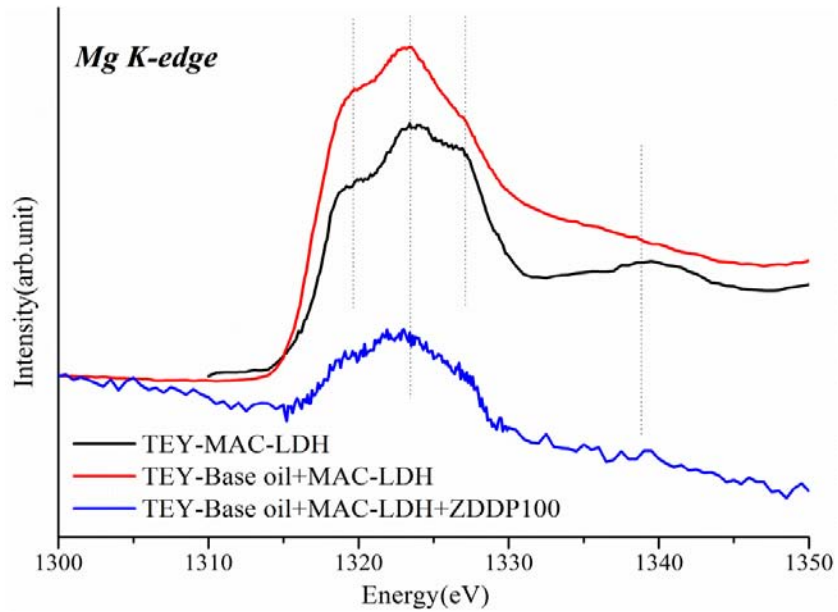
# Tribofilm Morphology



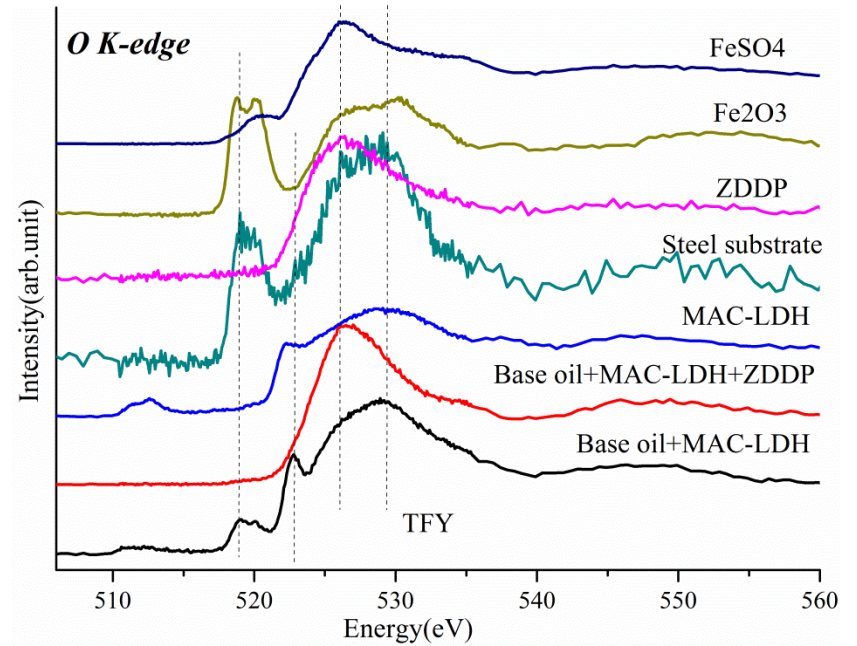
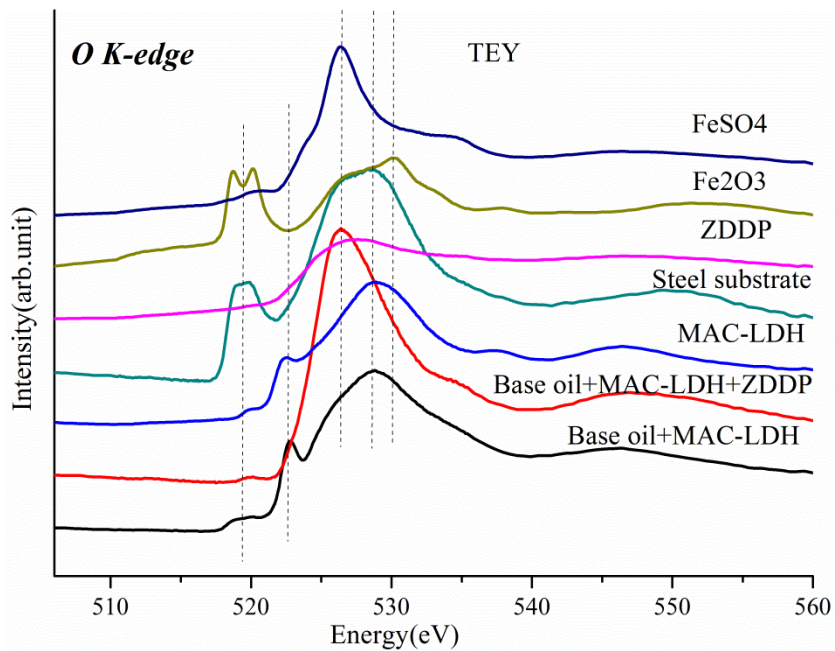
# Elements distribution of tribofilm



# XAS analysis of the tribofilm



# O K-edge of tribofilm





# Conclusion and prospects

- The base oil with MAC-LDH presents better friction-reducing antiwear properties than the base oil without MAC-LDH under 100°C. A tribofilm containing Mg, Al, C, O indicates that the MAC-LDH plays an important role in the tribofilm formation. MAC-LDH does not participate in tribofilm formation when using it and ZDDP together, which is contrary to base oil with Co-LDH and ZDDP. The structure and phase of MAC-LDH changed after friction.
- Study on the tribological performance of Co-LDH, Mg-LDH, Ni-LDH under different conditions, and figure out the reason for the performance difference. Investigate the surface morphology and the mechanical property of tribofilm using AFM. Use the XANES to characterize the chemistry of tribofilm and figure out the chemical process and antifriction mechanism of that.

**Thank you!**