

Ionothermal Synthesis of Layered Zirconium Phosphates and Their Tribological Properties in Mineral Oil

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Table S1 Details of the synthetic conditions for zirconium phosphate materials^a

HF	ZrOCl ₂	H ₃ PO ₄	DES	DMP ^b	Conditions	Phase
1	1	1	26	0	3days, 180°C	amorphous
2	1	2	26	0	3days, 180°C	α-ZrP
2	1	3	26	0	3days, 150°C	α-ZrP
2	1	2	26	1	3days, 180°C	ZrPO ₄ -DES8
2	1	2	26	3	3days, 180°C	ZrPO ₄ -DES8
2	1	2	26	5	3days, 180°C	ZrPO ₄ -DES8

^a Initial reaction compositions with molar ratio. ^b 1,4-dimethylpiperazine

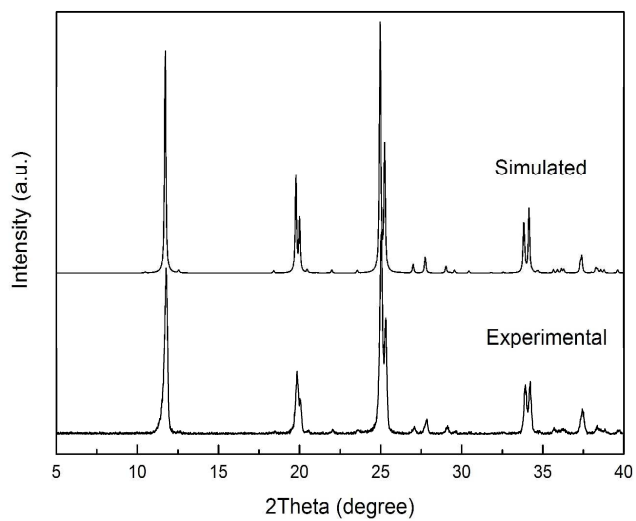


Figure S1 Experimental and simulated X-ray power diffraction patterns for α -ZrP phase

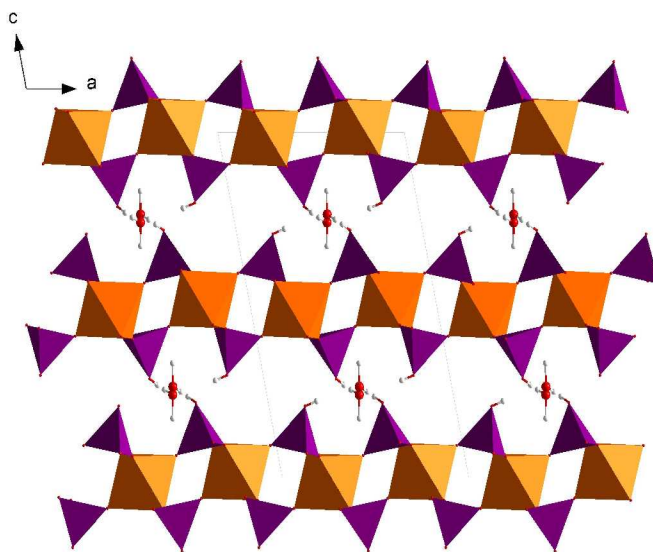


Figure S2 The layered structure of α -ZrP viewed parallel to the b axis
(PO_4 : purple, ZrO_6 : orange, water: red).

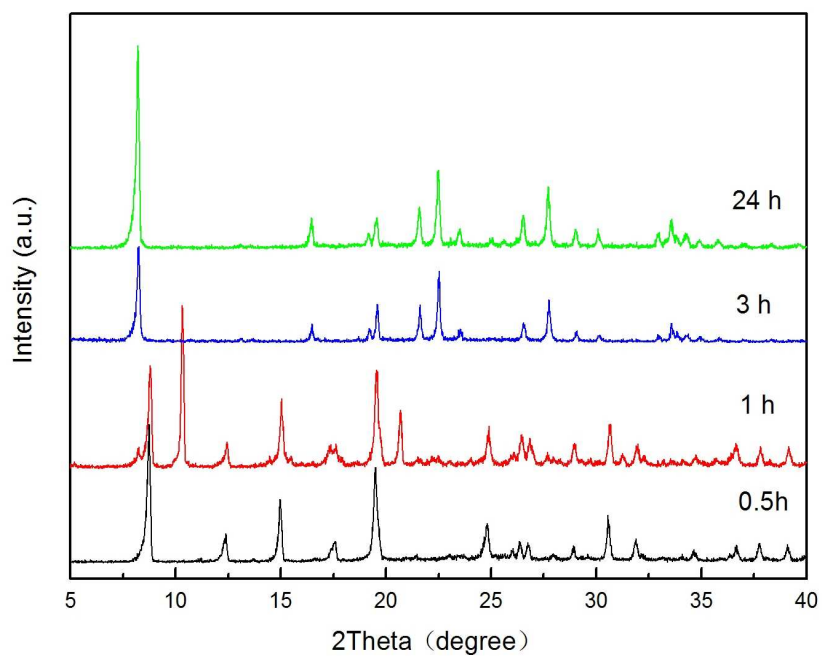


Figure S3 XRD patterns of the samples from different crystallization time

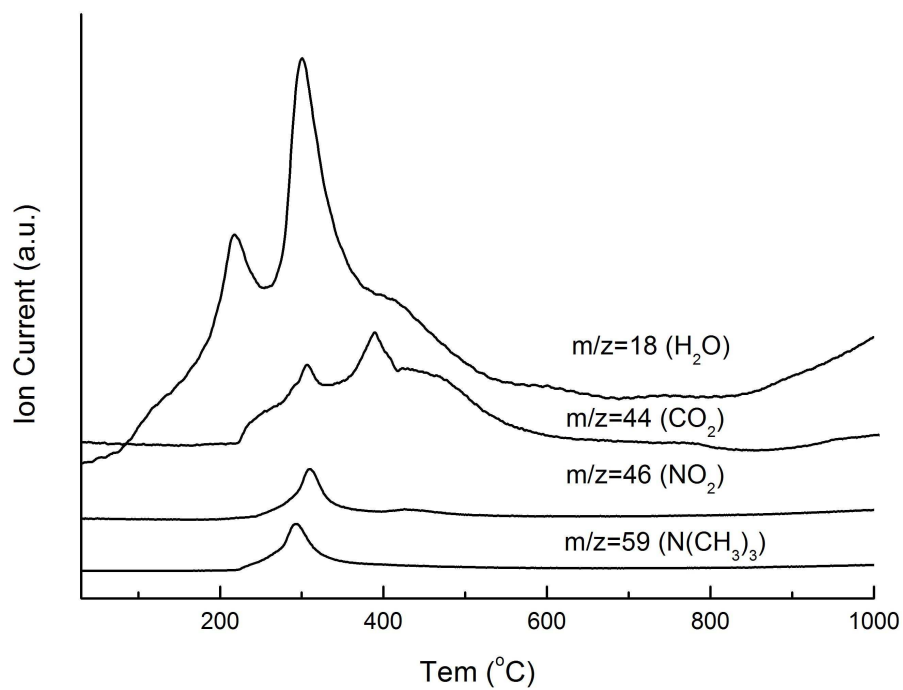


Figure S4 Mass spectrum of the evolved gases of the $\text{ZrPO}_4\text{-DES8}$ in the temperature range 30-1000°C.

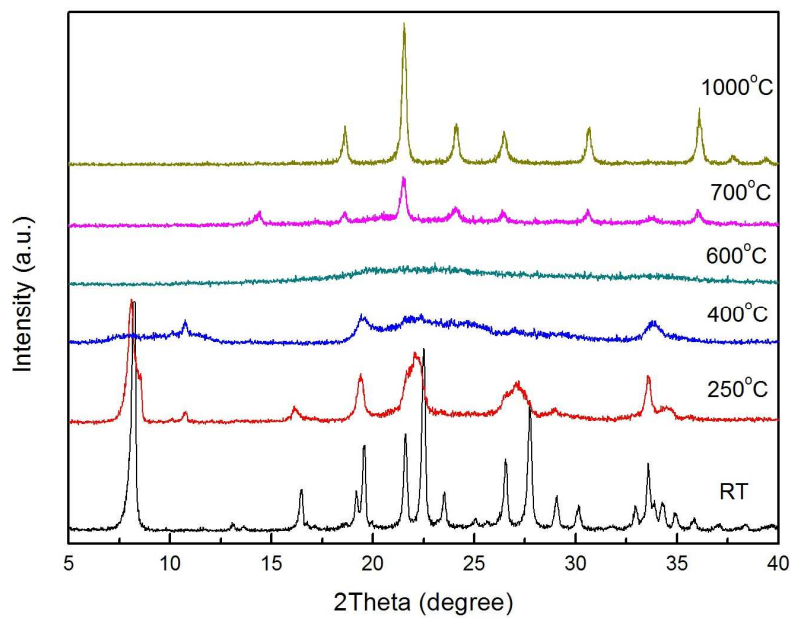


Figure S5 Powder XRD patterns of $\text{ZrPO}_4\text{-DES8}$ after calcination at different temperature

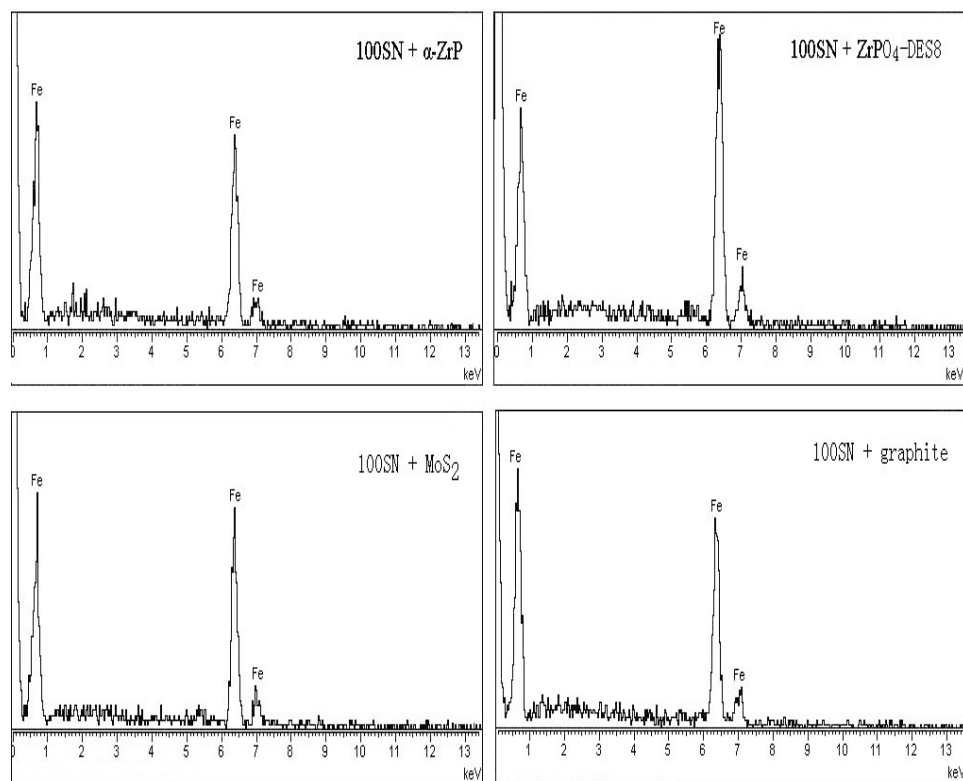


Figure S6 EDS of the wear scar surface lubricated with 100SN oil + different layered materials