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# Supplementary Information

## Study on the Synthesis and Tribological Properties of Anti-corrosion Benzotriazole Ionic Liquid

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The synthesis of IL $BTAP_{4444}$ as follows: BTAH was mixed with equal molar amount of $P_{4444}OH$, which was stirred at RT for 24 h. Then, dichloromethane (DCM) was added into the reaction mixture to extract the coarse IL product, and the DCM extractant was washed three times with distilled water to remove the non-reactant material and water soluble byproducts. DCM was removed by rotary evaporator. Finally the solution residue was further purified by vacuum drying at 70 °C for 24 h. After these steps, the target IL $BTAP_{4444}$ was obtained successfully.

The structure and purity of $BTAP_{4444}$ was finely confirmed by $^{1}H$ NMR, $^{13}C$ NMR, FT-IR and HRMS spectroscopic data. The detail data are presented below:

$BTAP_{4444}$: $^{1}H$ NMR (400 MHz, $CDCl_3$) δ (ppm), 7.76 (d, *J*=8.0 Hz, 2 H), 6.98 (dd, *J*=8.0, 4.0 Hz, 2 H), 1.78 (t, *J*=16.0 Hz, 8 H), 1.38-1.18 (m, 16 H), 0.85 (t, *J*=8.0 Hz, 12 H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ (ppm), 145.44, 120.18, 116.23, 23.74, 23.59, 23.40, 23.35, 18.32, 17.85, 13.32.

FT-IR (neat, cm-1): 2960, 2930, 2867, 1648, 1275, 740.

HRMS: m/z (ESI, positive ion) calc. 259.2555, found 259.2554 [$C_{16}H_{36}P^{+}$], m/z (ESI, negative ion) calc. 118.0405, found 118.0408 [$C_6H_4N_3^{-}$].

The 3D optical microscopic images were shown as fallowing which were consistented with the wear scars obtained during the sliding process.

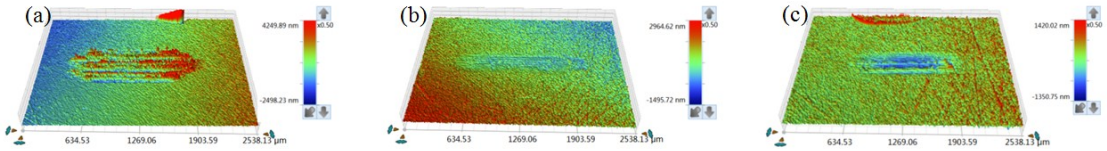


Fig. S1 The 3D optical microscopic images of wear scars (steel/steel friction pairs) after the friction tests at RT.

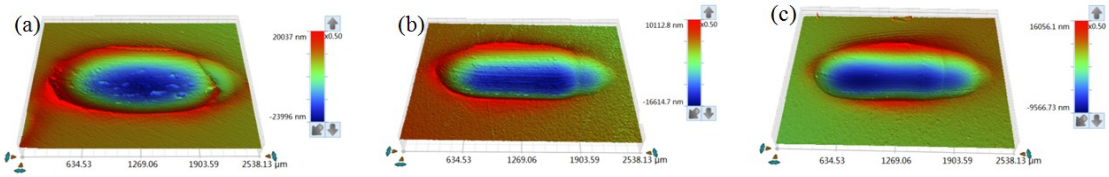


Fig. S2 The 3D optical microscopic images of wear scars (copper/steel friction pairs) after the friction tests at RT.

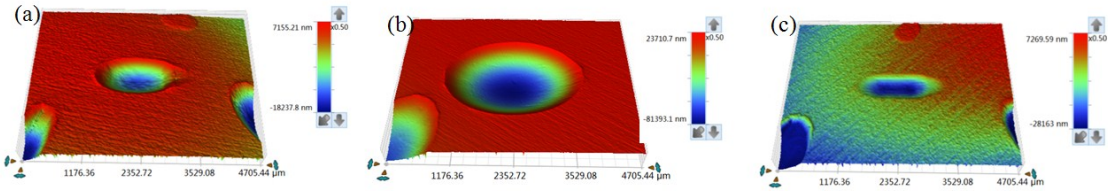


Fig. S3 The 3D optical microscopic images of wear scars (aluminum/steel friction pairs) after the friction tests at RT.

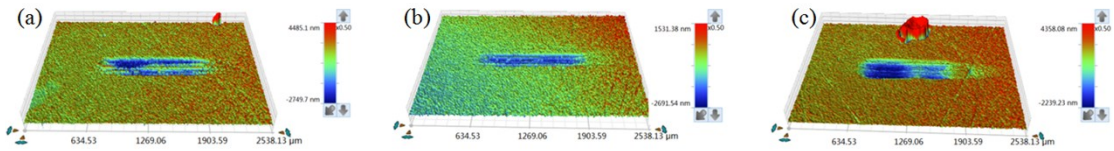


Fig. S4 The 3D optical microscopic images of wear scars (steel/steel friction pairs) after the friction tests at 100 °C.

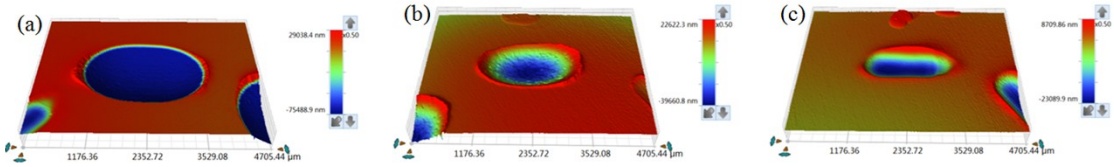


Fig. S5 The 3D optical microscopic images of wear scars (copper/steel friction pairs) after the friction tests at 100 °C.

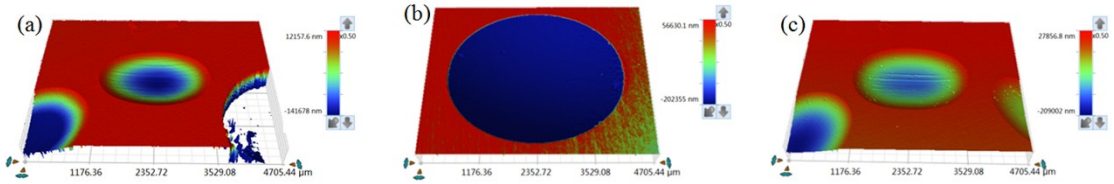


Fig. S6 The 3D optical microscopic images of wear scars (aluminum/steel friction pairs) after the friction tests at 100 °C.