Electronic Supplementary Material (ESI) for RSC Advances.

SUPPORTING INFORMATION

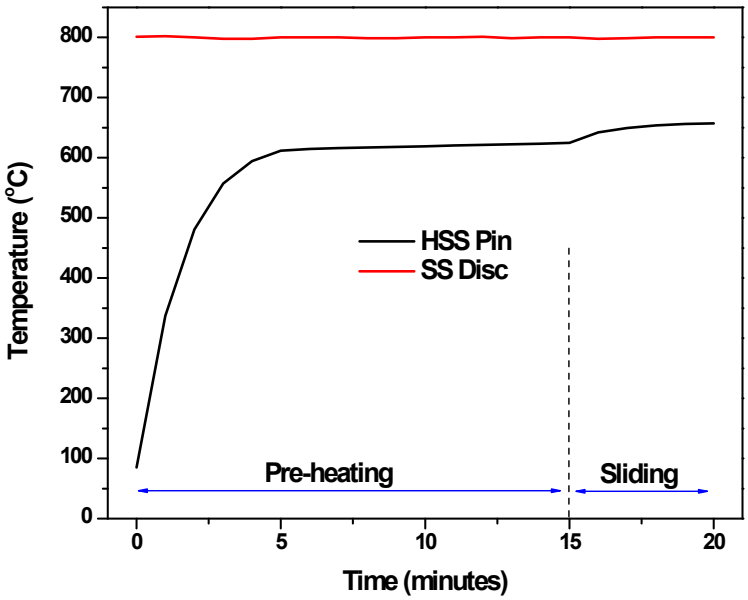


Figure S1: Temperature evolution of steel tribopair during pre-heating and sliding stage

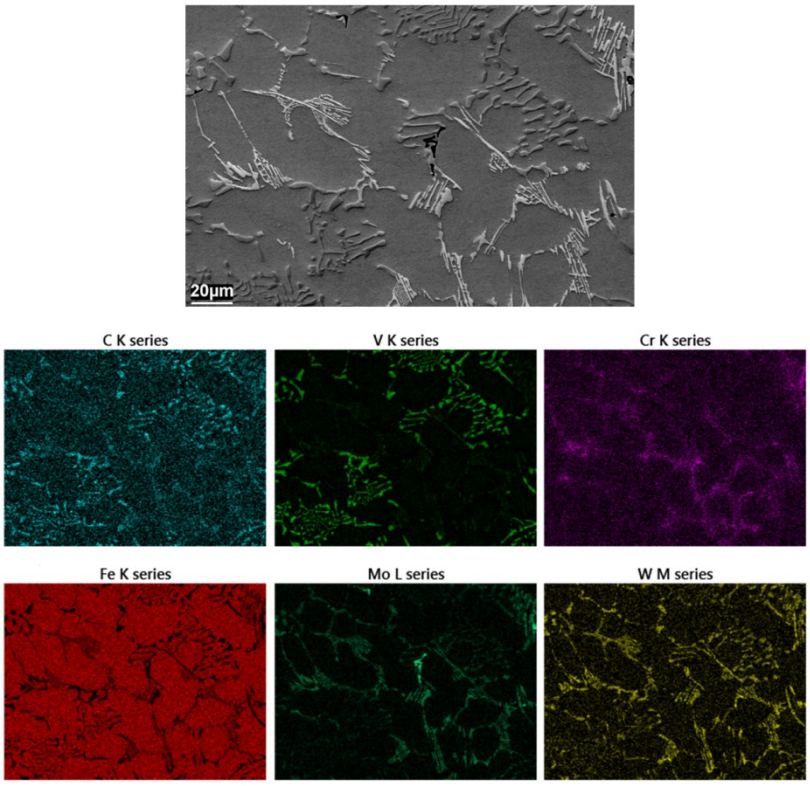


Figure S2: SEM image the EDS mapping of polished HSS substrate

Carbides formation with dendritic appearances rich in C and V, Cr, Mo, W can be distinguished from steel matrix in Figure S2.

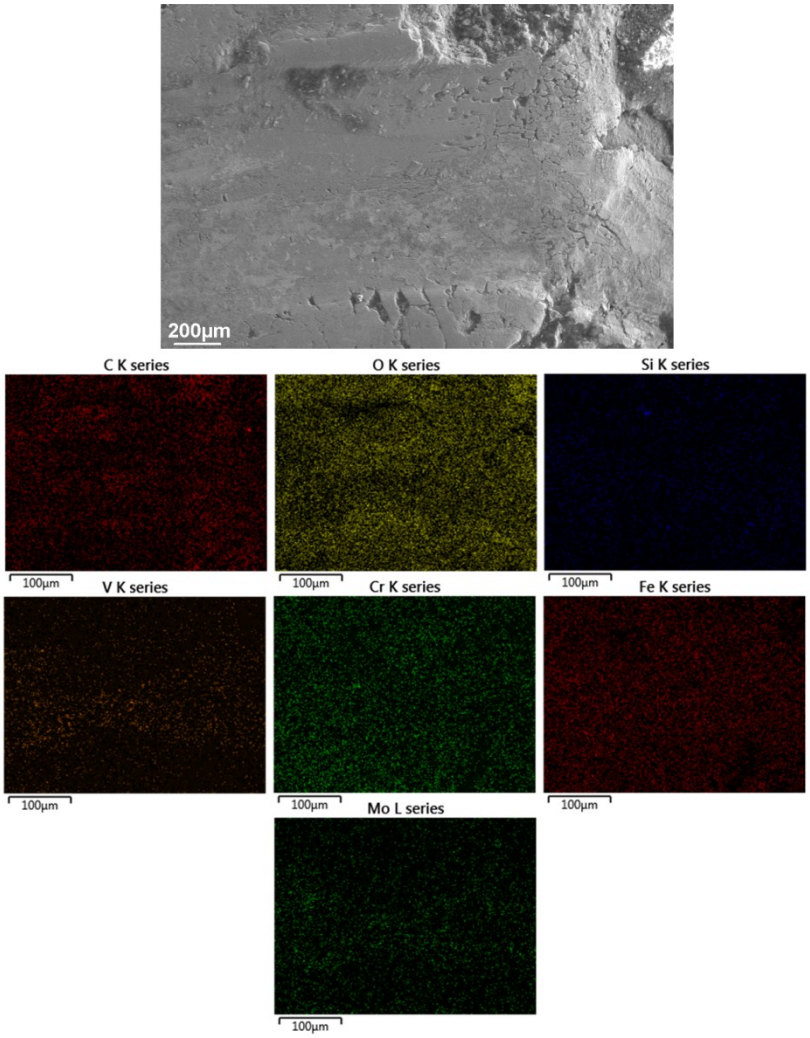


Figure S3: SEM image the EDS mapping of HSS pin lubricated by B_2O_3 at 10N

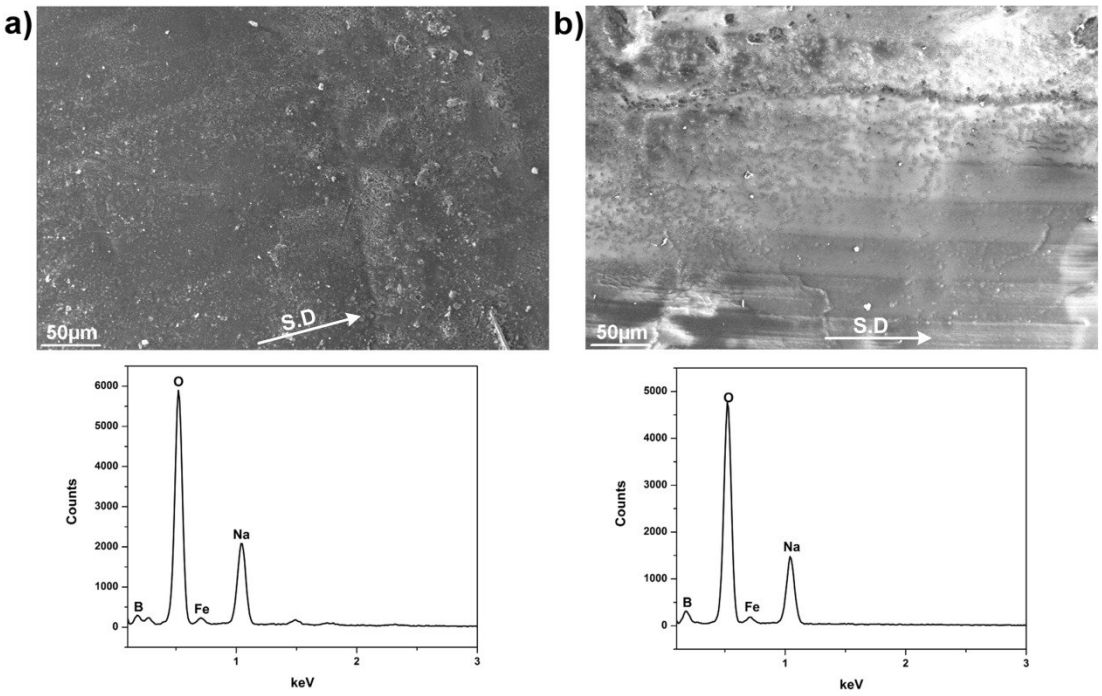


Figure S4: Worn surface morphologies and corresponding EDS spectrum of tribopair lubricated by Na_2O-B_2O_3 at 20N a) pin, b) disc

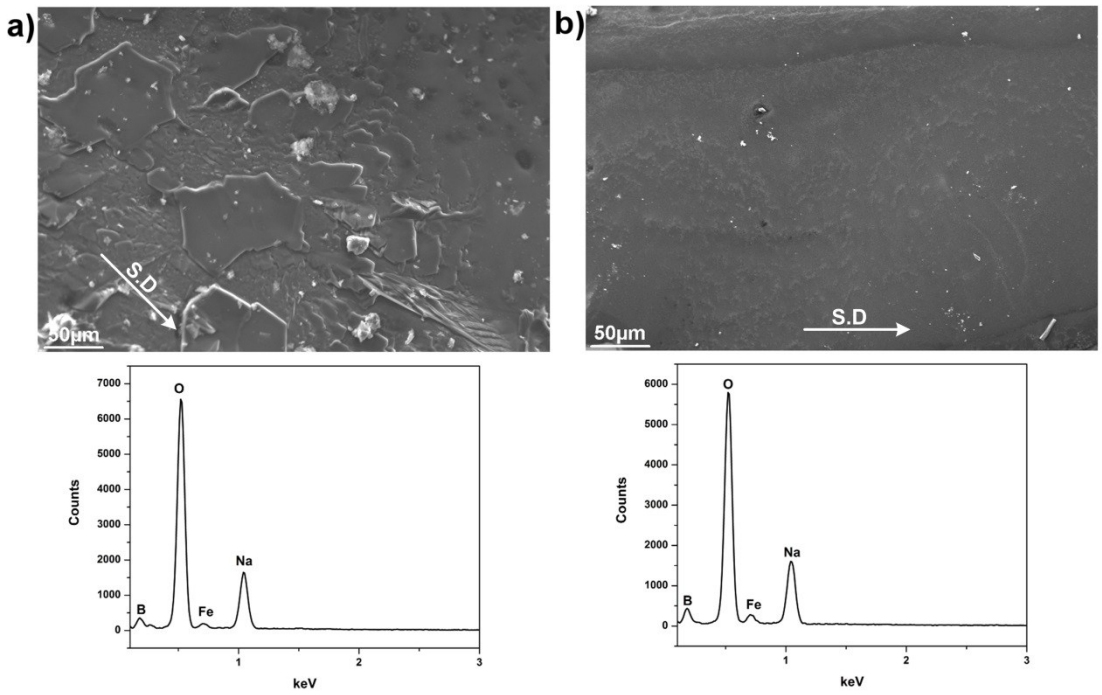


Figure S5: Worn surface morphologies and corresponding EDS spectrum of tribopair lubricated by Na_2O-B_2O_3 at 30N a) pin, b) disc

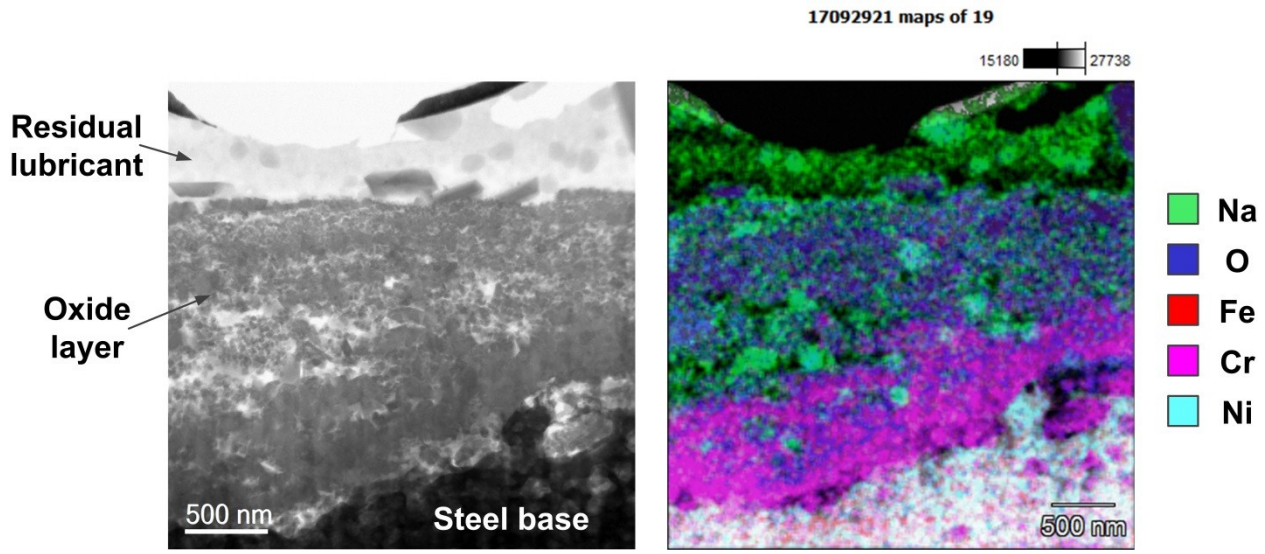


Figure S6: Migration of Na into the deformed scale on SUS316 disc lubricated by Na_2O-B_2O_3 at 30N

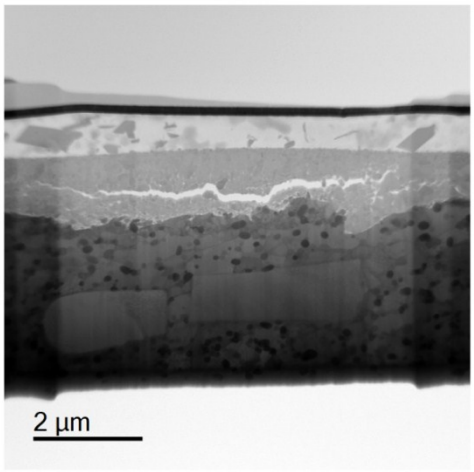
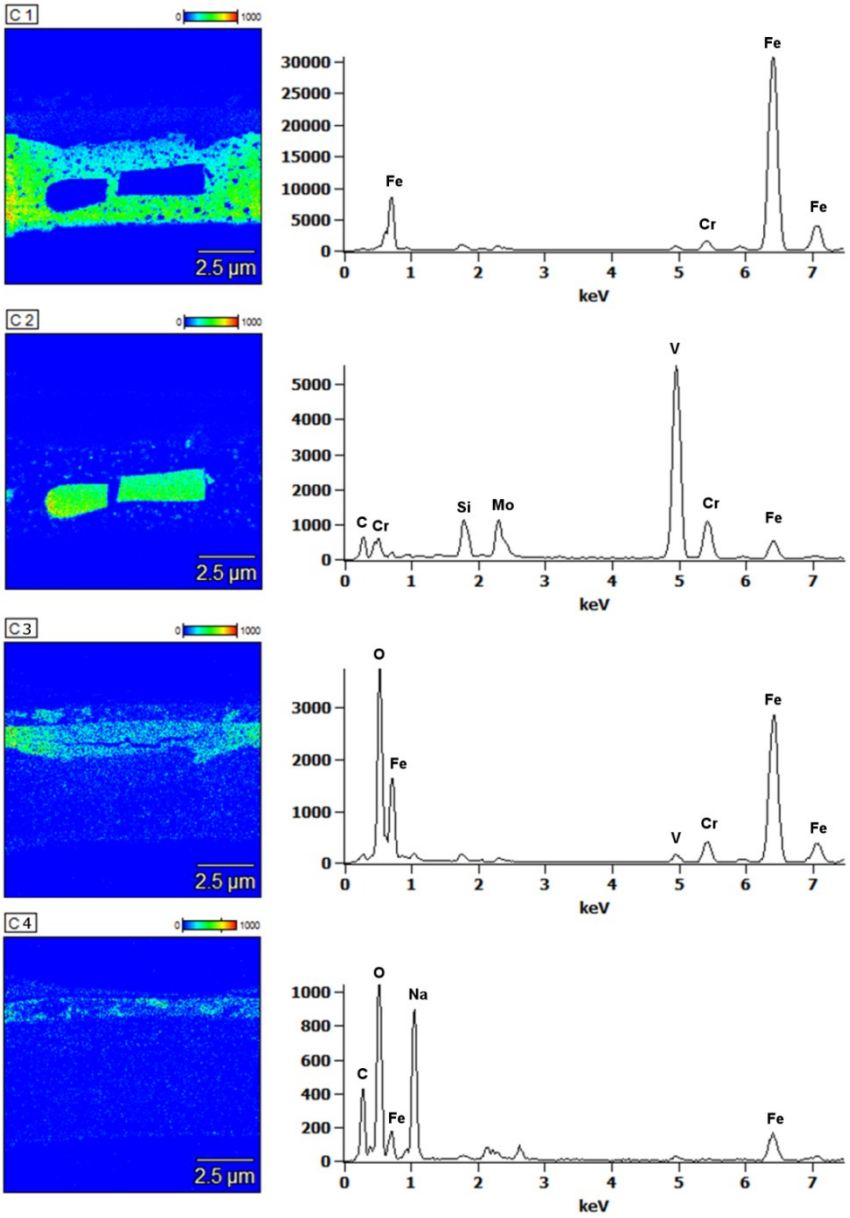


Figure S7: STEM-BF image of HSS pin lubricated by Na_2O-B_2O_3 at 30N and the corresponding EDS phase mapping



In Figure S7, distinct phase can be differentiated by the followed-up EDS spectrum. C1 corresponds to the steel matrix, C2 is assigned to the V-rich carbide, C3 is the grown oxide scale and C4 is the lubricant melt. It is noted that the central crack was caused by an incident during the lift-out of FIB specimen as it accidentally collide with the Cu grid. Beside that artefact, the oxide scale appears very intact and free from deformation with an astonishingly-smooth interface.