

X-ray Absorption Spectroscopy and Morphology Study on Antiwear Films Derived from ZDDP on the Different Hardness Steel Substrates

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Abstract: X-ray absorption near edge structure (XANES) analysis has been used to characterize the chemistry of antiwear films formed in mineral base oil containing a zinc dialkyl dithiophosphate (ZDDP) additive. These films were formed by rubbing the surfaces with a reciprocating boundary contact on 1095 steel of the different hardnesses. The phosphorus L- edge XANES spectra show that these films differ slightly in chemical nature. Longer chain polyphosphates were formed on samples with higher hardness. The surface morphology of these films was investigated using atomic force microscopy (AFM). Furthermore, nanomechanical properties of these antiwear films were investigated by nanoindentation measurement. Tribological measurements of friction coefficients and wear scars indicate that the poorest antiwear film was formed at the softest substrate which has the biggest wear scar and the highest friction coefficient.

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- [1] C. Minfray, J. M. Martin, M. I. De Barros, T. Le Mogne, R. Kersting, and B. Hagenhoff, *Tribol. Lett.* 17 (2004) 351
- [2] J. M. Martin, *Tribol. Letter* 6 (1999) 1
- [3] Z. Yin, M. Kasrai, G. M. Bancroft, K. F. Laycock and K. H. Tan, *Tribol. Int.* 26 (1993) 383
- [4] J. M. Martin, T. Le Mogne, C. Grossiord and T. Palermo, *Tribol. Lett.* 2 (1996) 313
- [5] P. A. Willermet, D. P. Dailey, P. O. Carter III, P. S. Schmitz and W. Zhu, *Tribol. Int.* 28 (1995) 177
- [6] H. Spedding and R. C. Watkins, *Tribol. Int.* 15 (1982) 9
- [7] R. C. Coy and R. B. Jones, *ASLE Trans.* 24 (1979) 77
- [8] N.J. Mosey, M.H.Muser and T.K.Woo, *Science* 307(2005) 1612