

A Multi-Technique Characterization of ZDDP Antiwear Films Formed on Al (Si) Alloy (A383) Under Various Conditions

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The simulation of the lubrication of aluminum-silicon (Al-Si) alloy cylinder-bore conditions is an important goal in automotive tribology. The present study describes the use of X-ray absorption near edge structure (XANES) to determine the macro-chemistry of zinc-dialkyl-dithiophosphates (ZDDPs) antiwear (AW) films formed on A383, an Al-Si alloy. The temperature dependence of the chemistry and mechanical properties were examined using X-ray photoelectron emission microscopy (X-PEEM), and imaging indentation techniques. Our findings suggest that ZDDPs break down to form polyphosphate glasses which have different chemical natures which depend on the underlying substrate. Furthermore, the chemical nature of the films appears temperature dependent on both the macro- and micro-scale. Not only are the chemical species different, but the mechanical properties also differ, depending on the region upon which an AW pad is formed. Through the use of focused ion beam (FIB) milling we can determine the film thickness, which was previously estimated from the P K-edge XANES a real density of samples with known thicknesses¹.

1. *Gavin Pereira, Andreas Lachenwitzer, Masoud Kasrai, Peter R. Norton, T. Weston Capehart, Thomas A. Perry, Yang-Tse Cheng, Bradley Frazer, P.U.P.A. Gilbert, Tribol. Lett.* 2006 (in press).