The performance of zinc dialkyl-dithiophosphates (ZDDP) is vital to preventing wear in an engine. ZDDPs are common antiwear additives in engine oil. These compounds break down under high pressure and load to form a protective polyphosphate film at the contact points between two rubbing surfaces [1]. The films have been observed to be formed of high and low regions that vary height by 100-300 nm. The high regions form pad-like features that have been termed antiwear pads [2]. X-ray absorption spectroscopy has proven the films to be composed of a layered structure with long-chain polyphosphates in the bulk and short-chain polyphosphates at the surface [1]. Interconnection of the polyphosphates occurs through zinc and iron linkage forming a polyphosphate glass network. Very little is known about the mechanical properties of the films [2,3].

Through the use of atomic force microscopy (AFM) specific regions of an antiwear film have been located. X-ray absorption near edge structure (XANES) and X-ray photoelectron emission microscopy (XPEEM) will be used to examine the spatial distribution of chemical species in the derived ZDDP antiwear film. Nanoindentation experiments will be performed on the corresponding features to give the first correlation between chemical speciation, topography, and nanomechanical response of these select features.