Adsorption of fatty acids on steel and gold surfaces: An *in-situ* XPS study

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1. Introduction

Most of the traditional additives used in automotive lubrication, like ZDDP and MoDTC, are considered as source of pollution and are accused to have a major contribution to environmental concerns. Nowadays, with growing issue around the world on environment protection, these additives must be minimised or replaced with biodegradable molecules having the same efficiency while being friendly to the environment. In order to meet these requirements, automotive and oil industries are trying to develop new lubrication technologies based on biodegradable additives. Among these additives, fatty acids are widely used as friction modifiers in fuels and lubricating oils and could be good candidates to meet the environmentally concerns. Several studies have proved the efficiency of these additives under certain operating conditions [1-3] and many lubrication models have been proposed but none have been evidenced experimentally.

In this study we investigate the adsorption of stearic acid and other fatty acids on different steel surfaces by using XPS analysis. The objective is a better understanding of the effect of substrate on their mechanism of action.

2. Methodology

For the adsorption tests, metallic iron and pure iron oxide surfaces were prepared *in situ* by ion etching. Gold and AISI 52100 steel surfaces were also studied for comparison. After the surface preparation, the samples were transferred all together into the preparation chamber of the XPS analyzer and vapor of C18 fatty acid was introduced in the chamber for adsorption at different times. Afterwards the adsorbed layers were analysed by XPS to study the effect of substrate nature.

3. Results

XPS analysis of adsorbed layers shows that the substrate nature influences the adsorption type. Stearic acid molecules seem to chemisorb via the COOH group on metallic iron but only physisorb on iron oxide and gold. No adsorption is detected on contaminated surfaces before etching (Fig.1). These results are in good agreement with computer simulation results presented in another paper of this conference.

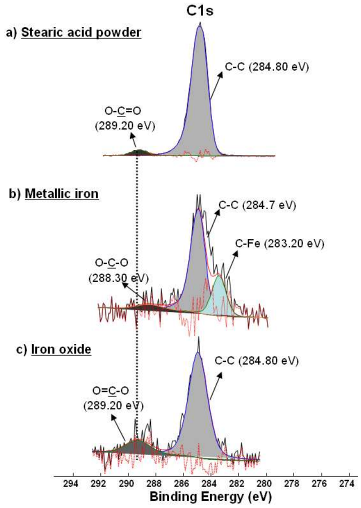

Fig.1: C1s XPS spectrum of: a) Pure stearic acid powder, b) Metallic iron and c) Iron oxide adsorbed surfaces

4. Conclusion

The adsorption mechanism of stearic acid and other fatty acids on steel and gold surfaces was studied by XPS technique. Results show that stearic acid adsorbs via the carboxylic group (COOH). Depending on the nature of the surface and its preparation, the type of the adsorption varies. Overall, these results are in good agreement with computer simulation studies presented in another paper of this conference.

5. References

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