Hybrid interfaces: probing a buried interface and characterization of environmental molecular influences

T. Hauffman[a,+], S. Pletincx[a], K. Marcoen[a], L. Trotochaud[b], J. Watts[c], H. Bluhm[b], H. Terryn[a]

[a] *Department Chemistry and Materials, Research group Electrochemical and Surface Engineering, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium*

[b] *Chemical Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, United States of America*

[c] *Department of Mechanical Engineering Sciences, University of Surrey, Guildford, GU2 7XH, United Kingdom*

Abstract

Interactions at the hybrid interface of organic coated metals determine largely the efficiency and durability of such systems. Analyzing this buried ultrathin region and characterizing the influence of atmospheric circumstances (such as water ingress) is challenging. Common surface sensitive analysis techniques only operate under vacuum conditions, making it impossible to probe environmental effects in-situ. Another drawback of common techniques is that they only probe the first top nanometers. In this work, we will present two novel methodologies to analyze the interface and determine aqueous influences, in order to unravel detrimental information. As such, an Ambient Pressure XPS was employed to unravel interfacial interactions of ultrathin films of polyacrylic acid with nano-tuned aluminum oxides in a humid environment [1]. An example of these measurements is shown in figure 1, where a clear influence of water on the bonding of the carboxylic acid with the oxide can be identified. However, these ultrathin polymeric films do no fully resemble the real hybrid structures' interface. The challenge remains to make the buried interface accessible without destroying its molecular structure. Therefore, we applied a unique ToF-SIMS – AFM – argon ion gas cluster combination, leading to a methodology to probe buried molecular interface fragments. Here the bonding of succinic acid with a well-tuned zinc oxide was characterized [2]. Specific ions, in which the metal-organic bond was preserved, could be identified as interface fragments.

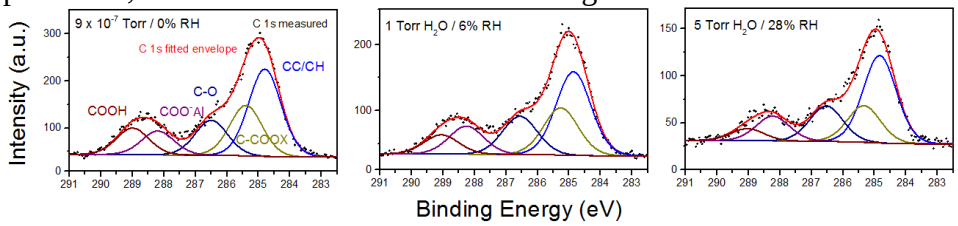

Figure 1: C1s spectra taken at different relative humidities, showing different relative intensities with respect to amount of bonds of the polyacrylic acid with the aluminium oxide

[+] Author for correspondence: tom.hauffman@vub.ac.be

[1] S. Pletincx, L. Trotochaud, L. Fockaert, J.M.C. Mol, H. Bluhm, H. Terryn, T. Hauffman, submitted to Nature Materials

[2] K. Marcoen, J. Watts, H. Terryn, T. Hauffman, manuscript in preparation