Development of an innovative methodology based on ToF-SIMS and XPS coupling for a local characterization of the oxide film formed on duplex stainless steel

Elise GARDIN[1], Sandrine ZANNA[1], Antoine SEYEUX[1], Audrey ALLION[2], Philippe MARCUS[1]

[1] *Institut de Recherche de Chimie Paris, CNRS - Chimie ParisTech, France*
[2] *Aperam Isbergues, Research Center - Corrosion & Surface Dept., France*

Duplex stainless steels (DSSs) are complex alloys with a two-phase microstructure composed of austenite and ferrite. Due to solubility differences of alloying elements in Face-Centered Cubic (austenite) and Body-Centered Cubic (ferrite) structures, the two phases of DSSs exhibit different chemical compositions: Ni and N contents are higher in austenite whereas Cr and Mo contents are higher in ferrite. Therefore, the oxide film at the surface of DSSs might also present a heterogeneous chemical composition. The oxide film composition is one of the key factors in the corrosion resistance of stainless steels, and Cr-rich oxide films are generally considered as more protective. Therefore, a difference in the Cr content of the oxide could induce a preferential corrosion of one of the phases. In this work, an innovative methodology was developed, based on the coupling of Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS) and X-ray Photoelectron Spectroscopy (XPS). The aim of this methodology was to characterize locally the oxide film formed on both phases of DX2304 DSS without any surface treatment. Two types of oxide films were investigated: the native oxide film formed after mechanical polishing and the passive film formed after passivation in 0.05 M H_2SO_4. The results reveal significant differences in the nature of the surface oxide films formed on the two phases, in particular higher Cr and Mo contents on the ferrite phase.