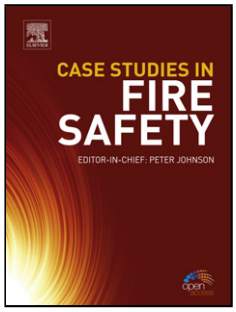

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New insight on early oxidation stages of austenitic stainless steel from *in situ* XPS analysis on single-crystalline Fe-18Cr-13Ni

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Abstract

In situ X-ray photoelectron spectroscopy real-time measurements and angular-dependent high resolution core level analysis were used for the first time to investigate the Cr enrichment and oxide growth mechanisms on a model 304 austenitic stainless steel surface in the very initial stages of oxidation leading to pre-passivation. The oxidation kinetics was followed for increasing oxygen exposure and temperature, revealing an early nucleation regime (for exposure < 10 L) leading to the formation of a strongly Cr-enriched Cr^{3+}/Fe^{3+} mixed layer followed by an oxide growth regime where preferential iron oxidation takes over and mitigate the initial chromium enrichment.

Keywords: *In situ* X-ray photoelectron spectroscopy (XPS); stainless steel; single crystal surface; oxidation kinetics; Cr enrichment; growth mechanism

1. Introduction

Stainless steels (FeCr-based alloys) are widely used because of their high corrosion resistance resulting from the formation of a continuous and protective surface oxide layer, the passive film. Numerous surface analytical studies have shown that the passive film is only a few nanometers thick and markedly enriched in Cr(III) oxide/hydroxide species [1–13]. Recently, it has been suggested from nanometer scale studies on austenitic stainless steels that

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