Intergranular corrosion of austenitic stainless steels in oxidizing nitric media

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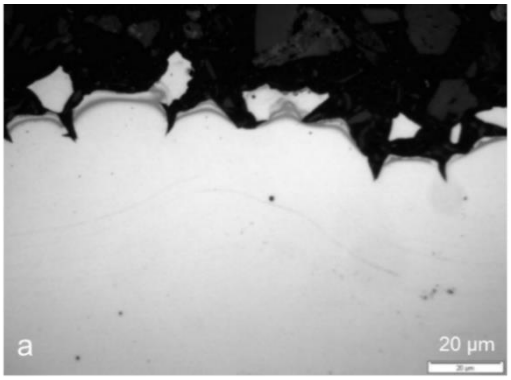

Figure 1 : Aspect of AISI 304L after 500h in boiling HNO_3 (5mol.L^{-1}) + [V^{5+}](10^{-2}mol.L^{-1})

- Corrosion in nitric media
- Silicon influence on corrosion behavior
- Chemical segregation at grain boundaries

Abstract:

In France, the recycling of nuclear fuel takes place in Areva's industrial centre of La Hague, using the PUREX process. The used nuclear fuel is dissolved in concentrated nitric acid kept at boiling temperature. Austenitic stainless steels, such as AISI 304L or 316L, are used as structural materials for equipments handling this very acidic media, due to their excellent behavior against corrosion due to the formation of a stable passive layer. During the dissolution of the fuel, oxidizing ions are released in the solution. It causes the corrosion potential of the steel to shift toward the transpassive domain, which leads to the apparition of a new form of corrosion, localized at grain boundaries. Only a special stainless steel (US1N), with 4% wt. of silicon, can resist this intergranular corrosion (IC).

Therefore the main purpose of this thesis is to determine the origin and mechanism of IC, mainly from a metallurgical point of view using different industrial stainless steels.
The first step is to study the influence of impurities (N, S, P, B) on IC. The ambivalent role of silicon, which can either enhance IC or protect the steel against intergranular corrosion, is more particularly studied
First, it requires to do some oxidation tests on some austenitic stainless steels, including US1N, in oxidizing nitric media, to confirm their behavior against IC.
Analyses with TEM-EDX will be conducted at grain boundaries to confirm or infirm the intergranular chemical segregation of impurities. Some model steel, with critical behavior againt IC, can be used as well to verify different hypothesis.