Investigation of single pit propagation on 316L stainless steel

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Pitting corrosion of stainless steel in chloride electrolyte is difficult to study experimentally since it results in a random succession of single or multiple events at the metal surface. To overcome these difficulties, a flow microdevice allowing the formation of a single pit at a given location on the alloy surface has been developed[1]. This electrochemical setup consists of a glass microcapillary connected to a syringe filled with chloride solution (Fig. 1 - left) permitting to finely control the amount of chloride ions in the vicinity of the pit.

This work aims at bringing new insight on the pit propagation description on 316L stainless steel. In a first step, the propagation phase is investigated and a particular attention is paid to the description of both radial and deep evolutions[2]. The use of different characterizing techniques, such as optical and SEM observations, Electrochemical Impedance Spectroscopy, Raman Microspectroscopy, and ICP analyses of the electrolytic solution, permitted to highlight the influences of the applied potential, the temperature of the electrolyte, the solution chemistry and the amount of chloride ions released. Then in the case of a pit repassivation, the possibilities to restart the propagation as a function of Cl^- supply and applied potential are investigated since the experimental device permits to perform pitting cycles on a single pit (Fig. 1 – right).

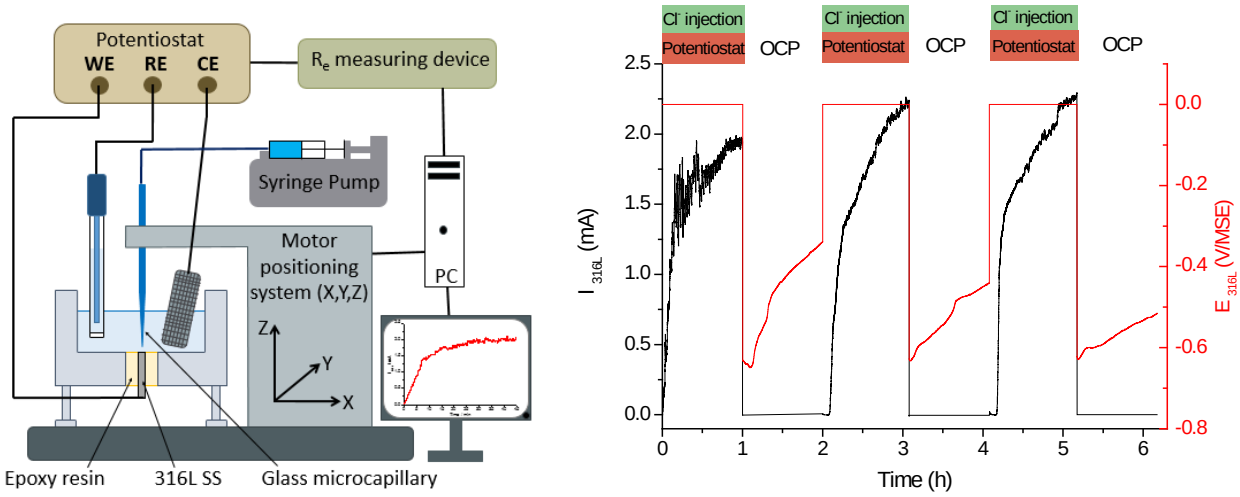

Figure 1: Electrochemical device developed for generating a single pit (left) and example of alterning the propagation and repassivation by opening the circuit and stopping the Cl^- injection for a single pit generated with the setup (right).

[1] N. Aouina, F. Balbaud-Celerier, F. Huet, S. Joiret, H. Perrot, F. Rouillard, V. Vivier, A flow microdevice for studying the initiation and propagation of a single pit, Corrosion Science 62 (2012) 1- 4.
[2] S. Heurtault, R. Robin, F. Rouillard, V. Vivier, Initiation and propagation of a single pit on stainless steel using a local probe technique, Faraday Discussions 180 (2015) 267-282.

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