



**Experiment title:** In situ X-ray emission study of the initial stages of galvanic corrosion of steel in sulphuric acid and sodium chloride electrolyte controlled by electrochemical potential

**Experiment number:**  
MA-3834

<b>Beamline:</b>	<b>Date of experiment:</b> from: 14/02/2018 to: 20/02/2018	<b>Date of report:</b> 23/03/2018
<b>Shifts:</b>	<b>Local contact(s):</b> Francesco Carla	<i>Received at ESRF:</i>

**Names and affiliations of applicants** (\* indicates experimentalists):

Jorg Zegenhagen (Diamond Light Source)\*

Debi Garay (Diamond Light Source and Amity University, India)\*

Vladyslav Solokha (Diamond Light Source and University Linz)\*

Carlo Meneghini (University Roma TRE)\*

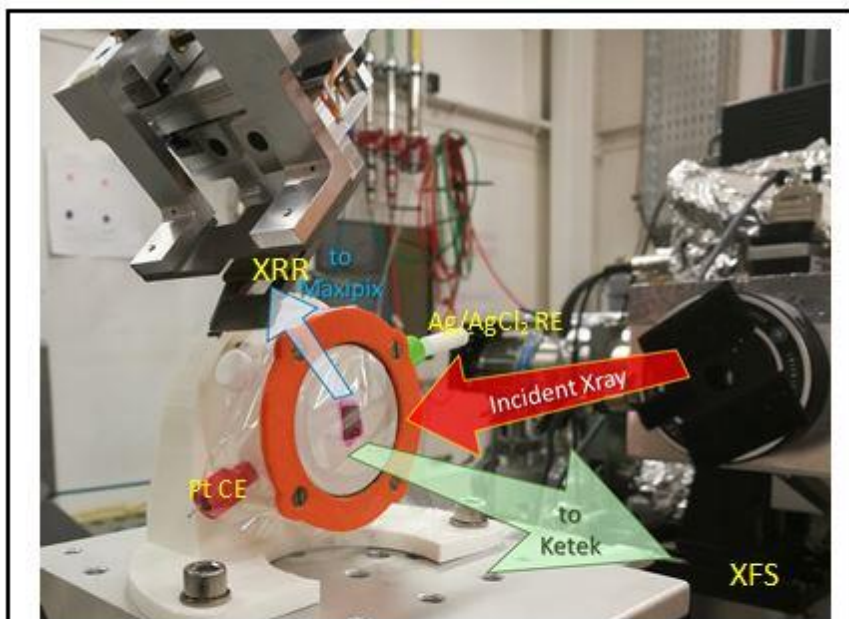
Ajay Gupta (Amity University, India)

**Also participating in the experiment:**

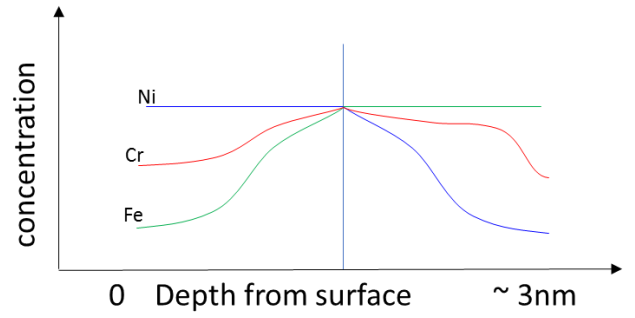
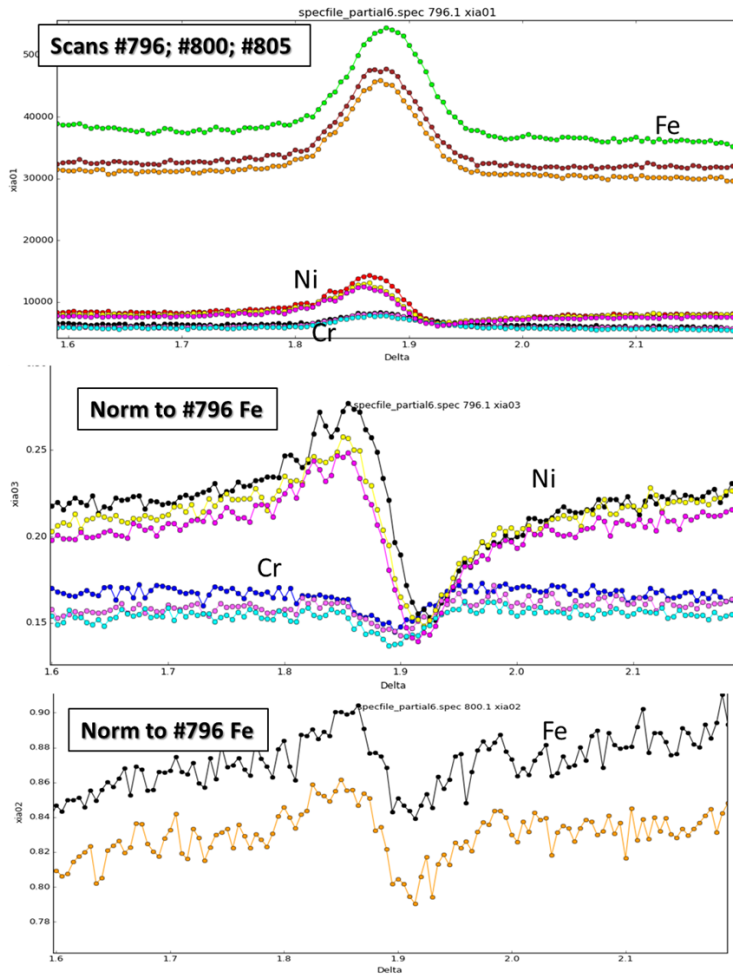
Ilaria Carlomagno (University Roma TRE)\*

**Report:**

We investigated the corrosion of thin films of steel (304L) by X-ray powder diffraction, X-ray emission spectroscopy and X-ray absorption spectroscopy, using X-ray fluorescence, as well as using the X-ray standing wave techniques. The in situ electrochemical cell in the set up at ID03 is shown in fig. 1. A significant amount of data is presently evaluated. Fig. 2 shows the results of an in situ XSW investigation. The 3 nm steel thin film on a B4C/Ru multilayer was exposed to 0.1 M KCl solution at 0.8 V (vs Ag/AgCl reference electrode) and the amount and depth distribution of the main steel components, i.e. chromium (~ 20%), iron (~ 65%) and nickel (~ 12%) was investigated in situ as a function of time during the corrosion process. Analysis of the data is in progress.



**Fig.2:** In-situ electrochemistry and corrosion experimental set up with Mylar cell at ID03, ESRF



**Left:** Results of the XSW analysis of the corrosion behaviour of SS 304L (30Å)/ on a Ru/B4C multilayer on silicon

**Above:** results of the analysis of the three metal components as a function of depth

The plot shows that after potential controlled corrosion at 0.8 V vs Ag/AgCl, the Fe signal is higher at low angles, related to surface regions. This means Fe is removed from the surface in the corrosion process .

- Compared to Fe, the amount of Ni is increased at the surface and decreases going deeper into the steel film.
- Cr shows the opposite trend, .

