# Change Of Chemical Species With Progress Of Crevice Corrosion

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## Abstract

One of the most destructive modes of corrosion of metals is localized corrosion. This can take many forms depending on the chemical and electrochemical environment of the metal. One important form is crevice corrosion, which occurs where two or more surfaces in close proximity lead to the creation of a locally occluded region. The narrow region makes exchange of solution between the interior and the bulk difficult, so changes in composition of the solution in a crevice occur much more quickly than that outside the crevice.

It is known that during crevice corrosion, metal dissolves at a large current density associated with the electrochemical reaction, which causes the solution composition, pH, and dissolved oxygen concentration to exceedingly vary. Typically, the width of crevice is several tens of μm or less, which is so thin that it is difficult to make an experimental measurement of environmental factors. Therefore, the numerical analysis technique is highly efficient.

In this work, we present a simulation research based on a two-dimensional model of crevice corrosion of stainless steel SUS304 in NaCl solution. The chemical equilibrium reactions in the solution are combined with the electrochemical reactions on the surface of SUS304. The simulation is performed using COMSOL Multiphysics®, in which the reversible reactions specifying equilibrium constants are used instead of the equilibrium reactions occurred in the solution and coupled with the Tertiary Current Distribution, Nernst-Planck interface. The approach is found to be efficient at the beginning stage of crevice corrosion because the arrival of the equilibrium state often takes a little while. The calculation results of various ion, oxygen, and hydrogen concentration distributions in the crevice are obtained and the pH value in the crevice is shown and evaluated.

Keywords: crevice corrosion, chemical equilibrium reactions in solution, pH value, O2 concentration, numerical analysis

## Reference

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[2] Y. Fukaya, T. Shinohara, “Solution characteristics of synthetic liquid in the crevice of stainless steel”, 66th Symposium of Materials and Environments in Japan, B-107 (2019) [in Japanese].

## Figures used in the abstract

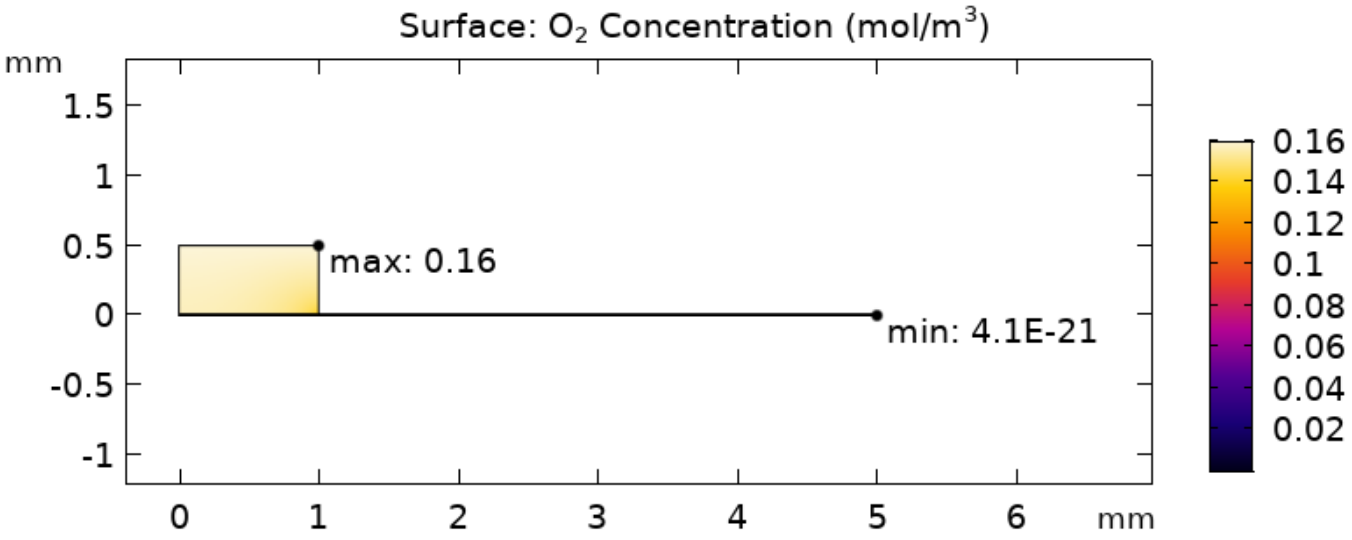


**Figure 1** : O2 concentration with its maximum and minimum values

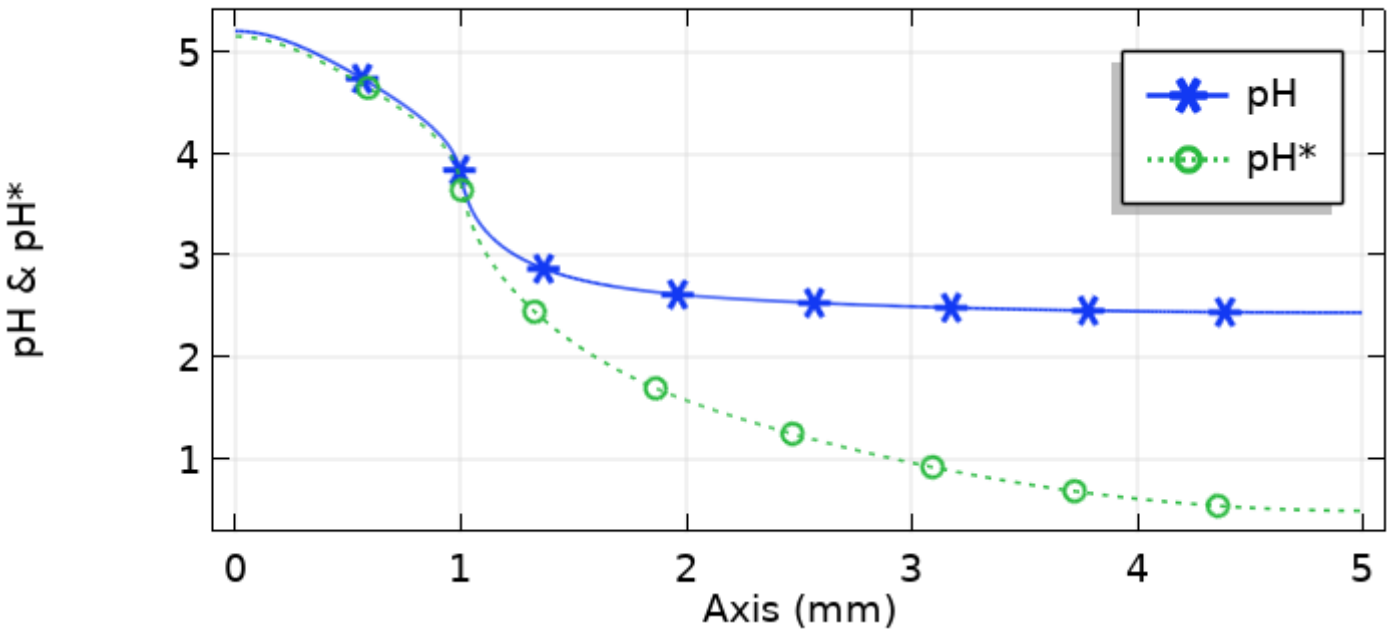


**Figure 2** : pH and its modified value pH* by activity coefficient in the crevice