Study of the effect of intergranular carbides in the behavior to stress corrosion cracking of Alloy 690 in supercritical water

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Nickel based alloy 690, which was designed as a replacement for the nickel based alloy 600, is widely used in the nuclear industry due to its optimum behavior to stress corrosion cracking (SCC) under nuclear reactor operating conditions. Because of this superior resistance, alloy 690 has been proposed as a candidate structural material for the Supercritical Water Reactor (SCWR), which is one of the designs of the next generation of nuclear power plants (Gen IV).

In spite of this, striking results were found when alloy 690 was tested without carbides in its microstructure. These results showed that, contrary to expectations, the crack growth rate is lower in samples without intergranular carbides than in samples with carbides. Therefore the role of the intergranular carbides in the alloy 690 and the mechanism behind it are not yet well understood.

Considering these observations, the aim of this work is to study the behavior of alloy 690 to SCC with and without intergranular carbides in deaerated supercritical water (SCW) at 400 ºC and 500 ºC and at 25 MPa. This work is completed with the study of oxide layers formed in SCW at both temperatures.