Comparison of Ceramic, Metal and Polymer Crevice Formers on the Crevice Corrosion Behavior of Ni-Cr-Mo Alloy C22

Xi Shan, Joe H. Payer
Department of Materials Science and Engineering
Case Western Reserve University, 10900 Euclid Ave, Cleveland, OH 44106
Contact author: 216-368-4218, joe.payer@case.edu

Abstract:

A necessary condition for crevice corrosion is that a crevice former create a sufficiently tight, restricted geometry on the metal surface to support the development of critical crevice chemistry. Crevice corrosion is affected by the crevice geometry (tightness) and the properties of the crevice former. The objective of this study is to determine the effect of the crevice former material on the evolution of localized corrosion-damage. A standard crevice corrosion test method is modified by (a) the use of ceramic, metal or polymer materials as the crevice former and (b) the variation of size and shape of the crevice. This study focuses on the post initiation stage of crevice corrosion and addresses factors that may limit the initiation of localized corrosion and also slow or stop the continued propagation of corrosion.

Controlled crevice corrosion tests are performed under aggressive, accelerated conditions on Ni-Cr-Mo alloy C-22 and other alloys for comparison. Multiple techniques are used to examine the crevice corrosion damage evolution. Current measurements during the test provide a direct measure of the corrosion rate and indicate the initiation and any stifling or arrest. The localized corrosion is found to be stifled or arrested under several test conditions. The corrosion damage volume and profile are quantitatively measured with optical and SEM 3D reconstruction methods. Analysis by SEM/EDS, XPS and AES show that the corrosion products within the damaged crevice area are enriched in W, Mo, O, while being depleted in Cr, Ni, Fe. The results on C-22, SS316 and other alloys show that a PTFE tape covered ceramic was the most active crevice former, solid polymer crevice formers (PTFE or Kel-F) are less active, while no distinguishable crevice corrosion was observed with a ceramic material only as the crevice former in direct contact with the metal. The affects are important to the determination of the penetration rate and extent of corrosion damage by localized corrosion.