

### **396e Hybrid Technique for the Monitoring of Diffusion of Water and Chromate within a Primer Layer**

*Bill L. Riehl, Jay Johnson, R.J. Wilkens, and Douglas C. Hansen*

Hexavalent chromium, Cr(VI), has been used effectively as a corrosion inhibitor in the aircraft industry for many years. However, chromium has been linked with genetic damage and has consequently been targeted to be banned by the EPA. Therefore a search for an effective lower toxicity replacement is being undertaken. To rapidly and successfully develop a replacement, the mechanism of inhibition and transport of Cr(VI) must be understood. Until now, there have been no studies addressing the lateral diffusion of the key chemical species, water and Cr(VI), in the primer layer, in situ. That is, until now, no one has directly measured water and chromate concentrations/fluxes lateral to the primer surface. This model most closely represents a defect in the coating system resulting from normal use. Using UV-VIS-NIR Attenuated Internal Reflectance Spectroscopy (AIRS) and Localized Electrochemical Impedance Spectroscopy (LEIS), the diffusion of the aqueous phase into dried primer films will be studied in conjunction with the release and diffusion of Cr(VI) within the primer layer. By monitoring the corresponding absorbance wavelengths of the aqueous phase (1460nm) and chromate phase (339nm), with a motorized track for the waveguide, it will be possible to spatially resolve the concentration of the aqueous and chromate phase with time and lateral position in the primer film. Simultaneously, the primer film will be monitored for changes in impedance, representing changes in the conductance of the primer phase, directly related to ingress of the aqueous phase. It will then be possible to correlate the data of the LEIS with the AIRS devices, providing a novel hybrid analytical technique for interrogating the primer layer in situ. This work will address the design and use of a spatially and temporally resolved sensing platform to directly measure the concentration of water and chromate in the primer phase, in situ. This will be the first application of such a hybrid technology to address the challenge of obtaining data for modeling the transport of water and chromate within the primer phase or coating.