NASA TECH BRIEF

Detecting Hydrogen-Containing Contaminants on Metal Surfaces

A spark emission spectroscopy technique has been developed for the analysis of surface contamination of metals. This technique can readily be applied in controlling the quality of surface preparations in addition to being useful in fundamental investigations of surface properties of metals.

The problem:

Porosity is by far the most common type of defect found in aluminum alloy welds. Hydrogen has been positively identified as the direct cause of porosity. The differential solubility of hydrogen in molten and solid aluminum and the subsequent precipitation (in the form of hydrogen bubbles) upon solidification has been identified as the mechanism for this porosity formation.

The solution:

Since the preparation of "good" weld joints presupposes a surface relatively free of absorbed hydrogen-bearing contaminants, a quantitative surface analysis is required to measure the contaminant concentration. It has been found that surface absorbants can be ionized by high-voltage sparks. A specially designed sparking chamber and support instrumentation for analyzing the emission structure of the ionization were assembled in order to utilize this technique.

How it's done:

A spark chamber has been constructed which makes it possible to measure background conditions and sample surface without disrupting the equilibrium of the system; the chamber consists of a brass base plate and cover, and a pyrex cylinder for the wall. A rotating stage carries the sample and the lower electrode, the upper electrode being supported by the top cover. A pair of standard electrodes is provided for internal calibration.

Carrier gas is injected through a diffusion plate into the chamber volume. Supporting hardware includes a LN_2 trap in the carrier gas line and controls for chamber pressure and gas flow rate.

Standard operating procedure employed with the chamber consists of a twenty minute purge of the system with a 95% He-5% Ar mixture, a one minute preblank spark between the calibration electrodes, a five minute purge during which the sample specimen is positioned below the upper electrode, a one minute sparking of the specimen, another five minute gas purge and a final spark calibration. Spectrographic plates are exposed during each spark cycle and analysis of the recorded emission structure is performed by conventional densitometric procedures.

Note:

Further documentation is available from:
Clearinghouse for Federal Scientific and Technical Information
Springfield, Virginia 22151
Price $3.00
Reference: TSP69-10192

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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