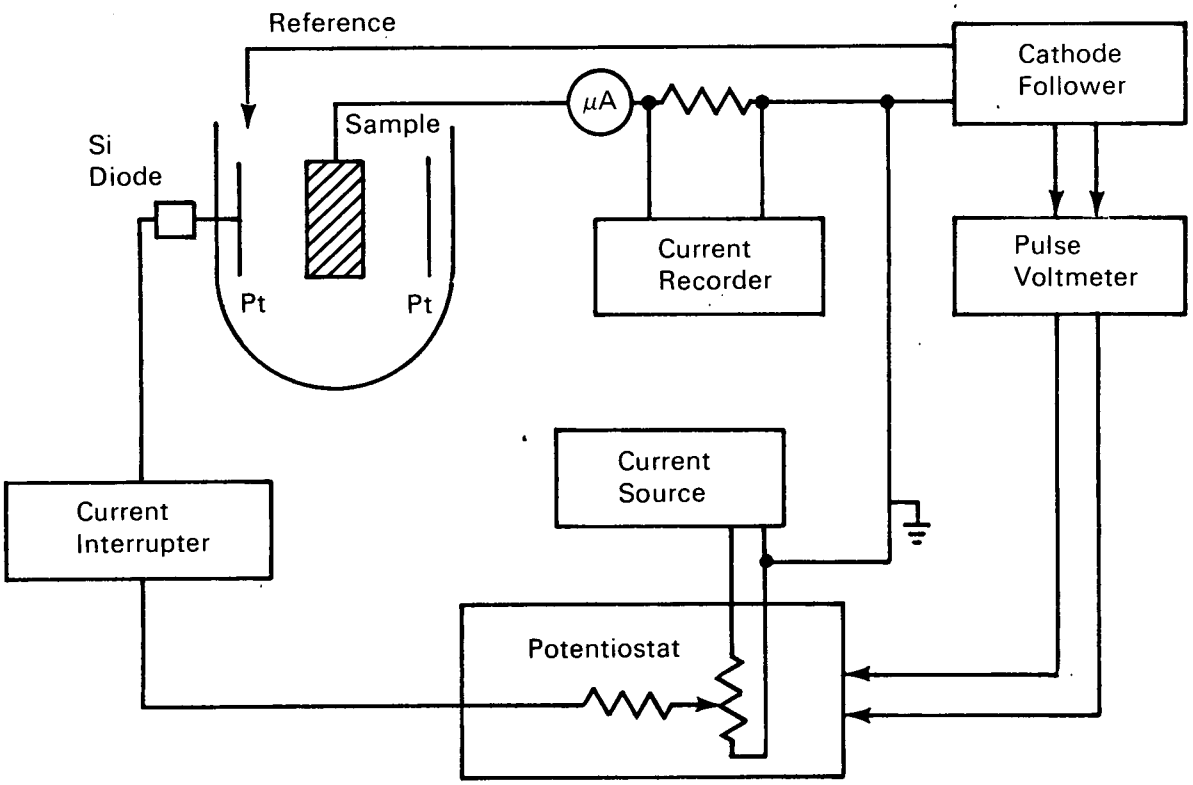
AEC-NASA TECH BRIEF

Instrumentation for Potentiostatic Corrosion Studies With Distilled Water



The problem:

To measure the potential of a corroding specimen in high-resistance media such as distilled water. It is advantageous to measure the potential of the sample metal when no current is flowing.

The solution:

Corrosion may be studied potentiostatically in the corroding environment of distilled water with an instrument that measures the potential of the corroding specimen immediately after interruption of the polarizing current. The process is essentially continuous, with interruption of the current for 6 msec of every 100-msec period. A method is described for control of the polarizing current at a preset level (*1*). The process permits compensation for ir drops when potentiostatic control is used in high-resistance systems.

How it's done:

A simple potentiostat circuit is connected to the pulse voltmeter through an adjustable-bias voltage

(continued overleaf)

supply. Incorporated in the potentiostat are automatic means for adjustment of the polarization current for maintenance of the selected polarization potential between the sample and the reference electrode. Unidirectional polarizing current is employed for simplification of the system; current reversal, during a test, necessitates manual adjustment.

The pulse voltmeter circuitry is modified for connection into a potentiostat loop and for the benefits deriving from semiconductor components. The behavior of the control-loop system during corrosion studies of aluminum samples in 70°C distilled water is described (*1*).

Generally the geometry and materials of the sample-cell system determine its electrical behavior. The temperature of the cell is kept constant by a 70°C water bath. The corrosion medium is degassed distilled water. A hollow platinum cylinder, fitting closely inside the closed cell, serves as a current-carrying electrode. The sample is a solid cylinder of aluminum having its ends blanked with TFE fluorocarbon insulators for maintenance of equal current density at all exposed areas.

Normally between 75 and 90 V are supplied to the 20-kohm potentiometer. The current interrupter is a vacuum-tube circuit that interrupts the polarizing current for 6 msec once every 100 msec. The pulsating polarization current, flowing through the cell, produces a pulsating voltage pattern at the measurement terminals (the sample and reference-electrode contacts).

The pulse voltmeter receives a fluctuating voltage; its function is to determine the value of the voltage of interest, regardless of the value of the solution ir drop, and to provide a nonpulsating output voltage. A vacuum-tube cathode-follower input stage is employed to provide a high input resistance and minimum input capacitance, thus minimizing the amount of cell loading through the reference electrode.

The potentiostat uses thyratron voltage-discriminators that monitor the output voltage of the voltmeter; these tubes switch motor-control circuits to adjust a potentiometer in the current supply.

Reference:

1. C. A. Youngdahl and R. E. Loess, *J. Electrochem. Soc.* **114** (5), 489 (May 1967).

Note:

Inquiries may be directed to:

Office of Industrial Cooperation
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439
Reference: B69-10413

Source: C. A. Youngdahl and R. E. Loess
Metallurgy Division
(ARG-10409)

Patent status:

Inquiries concerning rights for commercial use of this innovation may be made to:

Mr. George H. Lee, Chief
Chicago Patent Group
U.S. Atomic Energy Commission
Chicago Operations Office
9800 South Cass Avenue
Argonne, Illinois 60439