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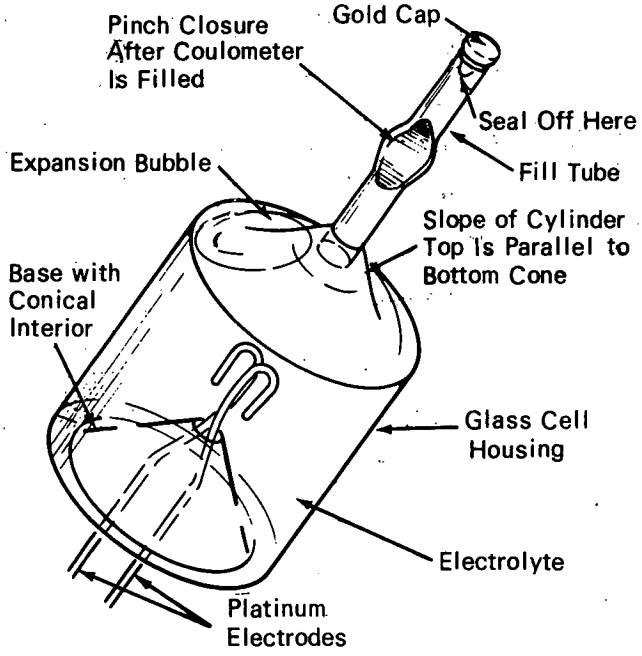
Brief 71-10176

AEC-NASA TECH BRIEF

Sandia Laboratories

Improved Reversible Coulometer Cell

An improved reversible coulometer cell has been designed. Its electrolyte, consisting of a 1.5% solution of silver perchlorate by weight in a dilute (0.25%) aqueous solution of sulfuric acid, appears



to be capable of storage in the cell for periods of greater than 5 years at temperatures ranging from approximately 218K to 348K (−55° to +75°C), with negligible deterioration and minimum residual charge effect. The cell is designed to operate in any physical orientation at accuracies of better than 2%, over a temperature range of 283K to 398K (10° to 125°C), with input currents ranging from a few microamperes to approximately 1000 microamperes, over periods of from 1 second to several hours.

The coulometer cell housing is a glass cylinder, with a conical interior at the base and a conical exterior at the upper end. A fill tube of platinum (or other material which will not react with the electrolyte) is bonded to the periphery of an opening in the upper cone. Sealed into the apex of the cell's conical base are two platinum electrodes with hook-shaped sections to maximize the plating area in a limited space. The electrodes inside the cell are gold-plated because the silver which is transferred as ions from one electrode to the other during operation of the coulometer adheres more readily to gold than to platinum.

A predetermined volume of electrolyte is introduced into the cell through the fill tube. Sufficient space is provided for an air (expansion) bubble to prevent damage due to expansion of the electrolyte under temperature extremes. The conical surfaces of the cell ensure that the bubble will not exclude electrolyte from any portions of the electrodes if the cell is inverted or otherwise reoriented. After the electrolyte has been introduced into the cell, a temporary silver electrode (not shown) is inserted through the fill tube. A current from an external circuit is then passed between the temporary electrode and one of the platinum electrodes for a sufficient time to allow a predetermined amount of silver (calculated from Faraday's laws) to plate the selected platinum electrode. At the end of the plating period, the temporary electrode is removed and the fill tube is sealed.

The platinum electrode leads extending from the assembled cell may be connected to appropriate circuitry to form a reversible coulometer that can be cycled to operate either as a timer or a current-time integrating device. For either purpose, the

(continued overleaf)

coulometer functions in accordance with Faraday's laws, as do conventional coulometers. The completion of one operational cycle (transfer of all the silver from one platinum electrode to the other) is signalled by a sharp voltage rise. This signal can actuate a switch or relay to operate another electrical device or reverse the current through the electrodes if cyclic operation of the coulometer is desired.

Notes:

1. The coulometer cell may be constructed with more than two electrodes. The electrical circuitry would then include relays to enable cycling the plating among the different electrodes to effect different current-time integration limits. If variable time periods are required (using a constant-current source), more than one electrode may be initially plated with silver, each with a different predetermined amount to correspond to the different time periods desired.
2. Requests for further information may be directed to:

   Technical Information Division 3416
   Sandia Laboratories
   Albuquerque, New Mexico 87115
   Reference: B71-10176

Patent status:

This invention has been patented by the USAEC (U.S. Patent Number 3,428,894), and royalty-free nonexclusive, revocable licenses for its use will be granted. Inquiries concerning license rights should be made to:

Assistant General Counsel for Patents
USAEC
Washington, D.C. 20545

Source: G. E. Boettcher
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(SAN-10051)