

Excess heats in a Pd(Pt)-LiOD+D₂O reflux open-electrolytic cell

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A heavy water reflux open-electrolytic cell was developed. It differs from the isoperibolic cell used by Fleischmann-Pons [1] and Miles [2] in a long branch tube opened to outside for escape of evolved gas in electrolysis and reflux of heavy water condensed on the inner wall at ambient temperature as shown in Fig. 1. The evaporation rate (4.32I in $\mu\text{g/s}$) and power (9.79I in mW) of D₂O in open electrolysis at 25°C are small constants, which are almost independent on the atmosphere pressure, and the power balance is simplified therefore. Mass losses in Pd-D₂O electrolysis were measured and the results verified that the actual amounts of evaporation were consistent with the theoretical value within 0.2% under careful design and operation. Excess powers the in the Pd(Pt)-LiOD+D₂O cell were measured by a Seebeck envelope calorimeter after denoising [3]. Four phenomena are observed: (1) Excess powers were more easily observed in Pt-D₂O(H₂O) than in Pd-D₂O system. The maximum excess powers were 79 ± 12 mW with input power of 4.1 W for Pt-D₂O system and 156 ± 12 mW with input power of 2.6 W for Pt-H₂O system. The reasons are unclear and this phenomenon has puzzled us for a long time because the Pt-D₂O(H₂O) cell is always considered as the reference system in experiments. (2) The maximum average excess powers were 19 ± 9 with input power of 4.2 W and 46 ± 3 mW with input power of 2.6 W for Pd-Cu and Pd-B rods, respectively, provided by M.H. Miles. (3) The open electrolysis is in unsteady state and this state can be divided into 2 categories, i.e. long-time shift and short-time fluctuation, by sorted of voltage or input power changing with time. For long-time shift, the excess power of instantaneous must be compensated by the time rate change of input power. For short-time fluctuation, the data logging rate cannot follow the changing of input power, the output power are always less than the input power for all Pd(Pt)-LiOD+D₂O cells. (4) The concentration of LiOD in heavy water solution decreases with time during open electrolysis and it was found that LiOD had turned into precipitation of Li₂CO₃ as verified by XRD. All these factors make the calorimetry to be complicated and the exact reproductions of excess heat in open-cells must be careful.

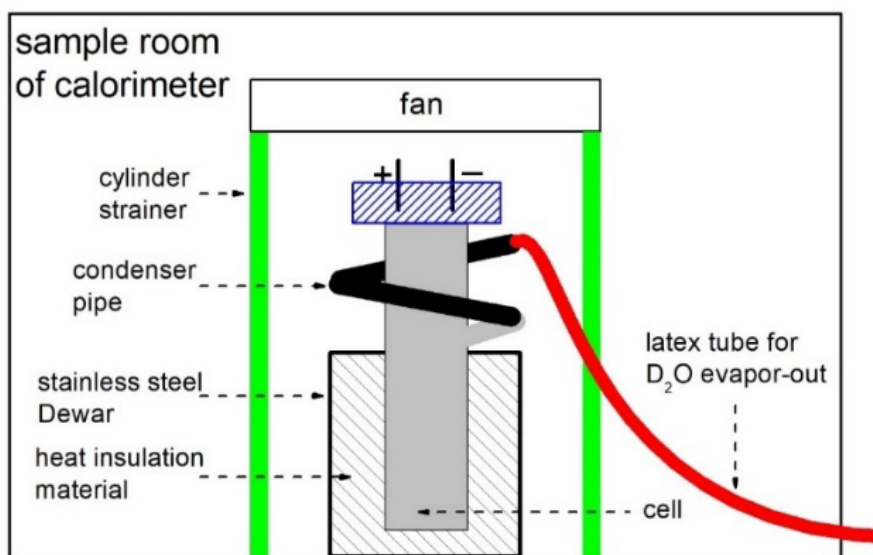


Fig. 1. Schematic of Pd-D₂O reflux open-electrolytic cell in the calorimeter.

References:

- [1] M. Fleischmann et al. J. Electroanal. Chem. 287 (1990) 293.
- [2] M.H. Miles, J. Condensed Matter Nucl. Sci. 24 (2017)1.
- [3] W.-S. Zhang, Convolution denoising of a large volume Seebeck calorimeter, Abs. of ICCF-23.