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EXCESS HEAT MEASUREMENT WITH PONS AND FLEISCHMANN TYPE CELLS

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Abstract

In experiments similar to the original Pons and Fleischmann description, we have done runs with palladium and platinum cathodes up to boiling in LiOD and Li_2SO_4. We show that up to 29% excess heat is produced at boiling, in accordance with our previous work, and in qualitative agreement with data obtained by Pons and Fleischmann but with lower magnitude. In addition we show that after boiling when the electrolyte is neutralized with sulfuric acid, excess heat is systematically observed at low temperature, even with platinum cathodes.

1 - Introduction

In their paper, Fleischmann and Pons [1] indicate that at boiling, excess heat is measured in large quantities. These experiments have been partially reproduced [2] with lower excess heat levels. It is the purpose of this paper to report on new boiling experiments under similar conditions, and also new low temperature and boiling runs in Li_2SO_4, that show systematic excess heat, even when the experiment in LiOD was negative.

2 - Experimental procedure

The details of the experiment are described in [1-3], and will not be detailed here. Let us simply emphasize that we use an open cell calorimetry. In the boiling experiments excess heat is deduced by the measurement of the difference between the energy necessary to evaporate the total water contained in the cell, and the energy input minus the radiated enthalpy. In the low temperature experiments, we have compared the K_{R11}, i.e. the emissivity coefficient of the cell, at 200 mA and 500 mA to calibrations with platinum in LiOD. The lower K_{R11}, the more excess heat is produced.

3 - Experimental results

3.1 - Boiling experiments

Table 1 shows the various excess heat measured during boil-off experiments for two different cells P2 and P3, similar to the original Fleischmann and Pons ICARIUS 2 cell[1].

Most data are obtained with palladium samples 2mm in diameter and 12.5 mm long. However we have indicated in the table data obtained with a 1mm diameter cathode, and with a 20 cm long 125µm in diameter palladium wire. In order to be as close as possible from the symmetrical electric field obtained in the normal operation mode, we have wound the palladium cathode cylindrically. Externally we have wound the first part of the platinum anode, the second part being an axial wire, so that the field comes both from the inside and the outside.

Table 1 shows that excess heat up to 29 % has been measured during boil-off. Experiments P97, PI 14, and PI 15 have been brought to boiling twice, once in LiOD, then in Li2SO4. The thin palladium wire experiment has produced an excess heat of 9%, similar to the average value. It can be seen that we systematically observe no excess heat with platinum, but we almost always measure excess heat with palladium cathodes.

Boiling Experiments in LiOD					
Cell P2			**Cell P3**		
Experiment	**Cathode**	**XSH**	**Experiment**	**Cathode**	**XSH**
88	Pt	0%	93	Pt	0%
90	Pd	12%	96	Pd-Rh	8%
91	Pd	20%	97	Pd	7%
95	Pd-Ce	5%		Pd Li_2SO_4	9%
98	Pd	14%	99	Pd	14%
107	Pd 1 mm	5%	106	Pd-Pt-Cu	11%
109	Pd	12%	108	Pt	0%
111	Pt	0%	112	Pd	0%
115	Pd	15%	114	Pd	29%
	Pd Li_2SO_4	13%		Pd Li_2SO_4	0%
			116	Pd wire	9%

Table 1: excess heat observed during boil-off with Pd and Pt cathodes

3.2 - Experiments in Li_2SO_4.

Tables 2 and 3 show K_{R11} for the two cells P2 and P3, respectively in LiOD, then in Li_2SO_4 for the same samples as in the above section. We must notice first that there are two values of K_R for platinum, i.e. the blank experiments at 200 mA and 500 mA. We do not have an exact explanation for this behavior, but we do not think that the temperature gradient in the cell is the cause, since we have made measurements at various locations in the cell without observing any significant temperature variation. A more realistic reason being that there is also some conduction at the top of the cell that we have neglected in the theoretical approach of the operation of the cell[2]. However we believe that a direct comparison between data at similar currents is valid. To check the influence of the temperature on the operation of the cell, heat has been added in order to increase the temperature of the cell without changing the current intensity. No significant variation of the K_{R11} has been observed.

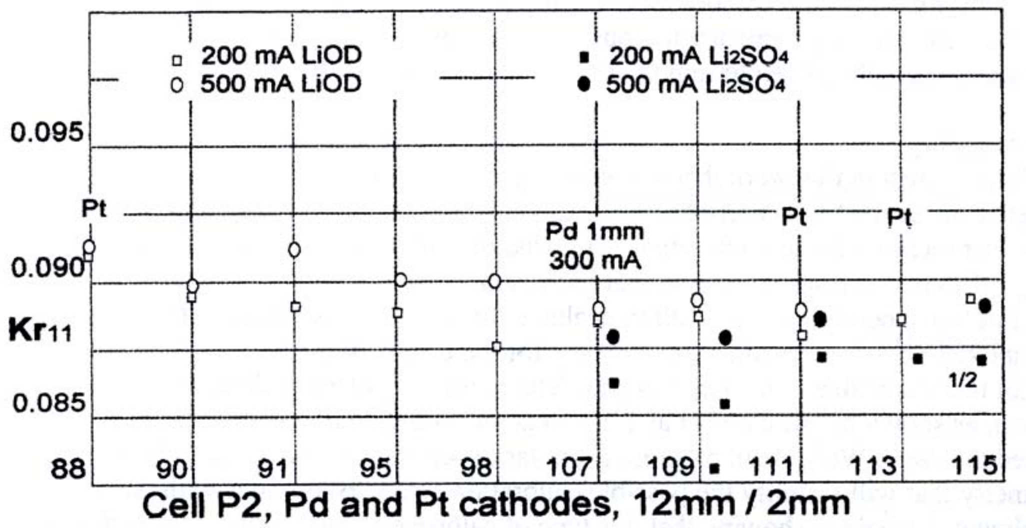

Table 2: K_{R11} of cell P2 at 200 mA and 500 mA in LiOD and Li_2SO_4.

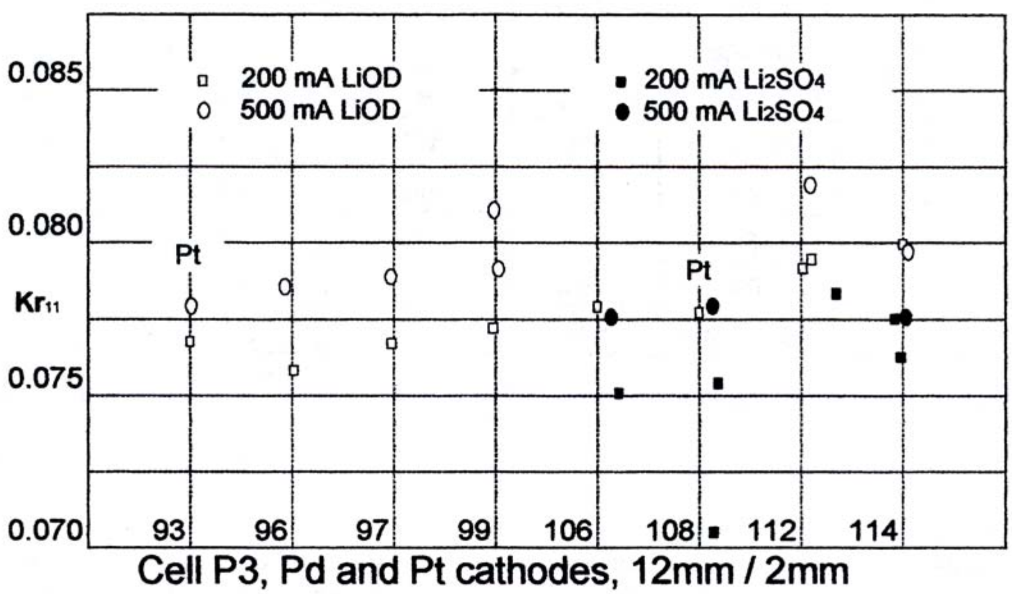

Table 3: K_{R11} of cell P3 at 200 mA and 500 mA in LiOD and Li_2SO_4.

From data shown in tables 2 and 3, it appears that in Li_2SO_4 there is excess heat even at low current, for palladium cathodes, but the big surprise is that platinum shows also excess heat. This result is in agreement with those obtained by J. Dash[4]. One reason could be that platinum can absorb deuterium under certain circumstances.

4– Conclusion

We have shown in this work that at boiling we observe excess heat of up to 29 %, in qualitative agreement with Fleischmann and Pons[1]. However the magnitude of the excess heat measured is less important than what they observe. Their analysis of the boiling off in two periods, assuming that the vast majority of the excess heat is produced at the end of the experiment is difficult to evaluate. In our previous work [2], this has been done, and has shown more dramatic numbers for the excess heat. In the present work we have not tried to evaluate the data this way. The boiling experiment deserves more attention, as shown by Roulette et al. [5] who demonstrated that more excess heat could be obtained that way. We have in progress a similar experiment, but with mass flow calorimetry that will simplify the possible calibration errors. Blank runs with platinum have already been done showing that this type of calorimetry has a sensitivity better than 2%.

The experiments in Li_2SO_4 are surprising since they seem to show that the palladium is more active, and that even platinum is active, in agreement with Dash[4].

At this point no nuclear ash has been observed, but experiments with ICP-MS are under way to analyze the samples.

References

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