MRG-059-ZD: Power measurement with different power settings from Joy-It with 470 nm II

Date: 2024-09-30
Tags: Radiation AE Calibration HTE Radiometry Power measurement
Status: Done
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Literature/reference experiments

Literature	/
Reproduction	/
Related experiment	Irradiation - AE-339: Radiometry of HP LEDs (405-, 415 and 6500-) using an Ulbrichtkugel I AE-341: Power measurement with different power settings from Joy-It with 470 nm

Procedure/observations

Power measured using [Power Meter] 843-R-USB + 919P-020-12 unless specified otherwise.

Date	Time	Step	Observations
30.09.24	07:50	The irradiation setup was build according to Protocol - Irradiation setup using Light Source - LCS-0470-50-22 and using the Equipment - Joy-it JT-RD6006 DC POWER SUPPLY to control the power input of the LED	setup.jpg, more fotos1, more fotos2
		The voltage output by the Joy-it JT-RD6006 was measured with a multimeter.	
		The distance of the lamp to the power meter were ca. 9.5 cm and the lamp was placed in a straight line to the power meters probe	
	7:55-10:14	The power output of the light source was measured at different voltages of the power supply.	Used voltages: 0.03, 0.05, 0.08, 0.1, 0.12, 0.18, 0.2, 0.3, 0.4 0.5, 0.8, 1.0, 2.0 V

		At the start of 10 min intervals the values (voltage and power output) are measured, afterwards the sensor is covered with a sheet of cardboard --> the measured power goes back to 0 and the sensor is protected. After 10 min the cardboard is removed and the values of measured voltage and power output are noted again before the next voltage is sampled. The exact measurement times are stated in the Measurements-table	
		After all voltages were tested, the programmable power supply and lamp power supply were left turned on and the next measurements were performed after 1 day with the same setup	
02.10.24	10:23	After all measurements were conducted, the setup was disassembled	

Measurements

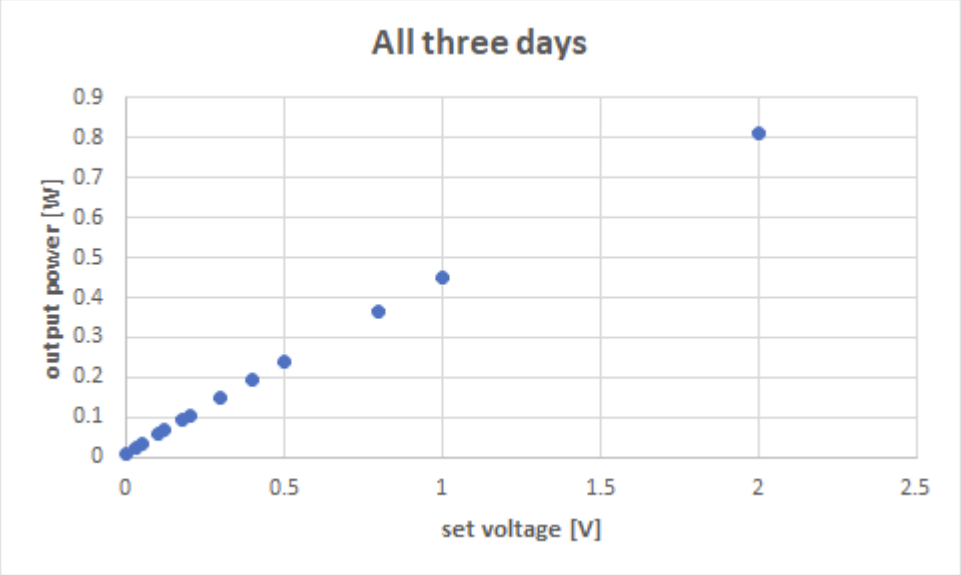
Date	Time at start of 10 min interval	Time since programmable power supply was turned on initially	Temperature of programmable power supply	Set voltage	obtained voltage (measured with multimeter) at start of 10 min irradiation interval	power output (measured with power meter) at start of 10 min irradiation interval	obtained voltage (measured with multimeter) at end of 10 min irradiation interval	power output (measured with power meter) at end of 10 min irradiation interval
		[h:min]	[°C]	[V]	[mV]	[W]	[mV]	[W]
30.09.24	07:55	00:05	19	0.03	39-42	0.026	39-42	0.028
	08:07	00:17	22	0.05	56-58	0.036	56-58	0.036
	08:20	0:30	25	0.1	107-109	0.060	107-109	0.061
	8:30	0:40	26	0.12	128-130	0.070	128-130	0.070
	8:42	0:52	27	0.18	188-190	0.098	188-190	0.098
	8:54	1:04	28	0.2	205-209	0.106	205-207	0.106
	09:04	1:14	29	0.3	307-310	0.150	307-310	0.150
	9:15	1:25	29	0.4	406-408	0.194	406-408	0.194
	9:27	1:37	30	0.5	508-510	0.240	508-510	0.240
	09:38	1:48	30	0.8	806-808	0.368	806-808	0.369
	09:49	1.59	30	1.0	1006-1008	0.452	1006-1008	0.451-0.452
	10:03-10:14	2:13	31	2.0	2005-2007	0.818-0.819	2004-2006	0.814-0.815
	7:30		30	0.00	voltage without any applied current (ca. 10 mV)			

01.10.24	07:32	23:37	30	0.03	38.5-41	0.025	38.5-40.5	0.026
	07:42	23:47	30	0.05	55.5-57.5	0.034	55.5-57.5	0.034
	07:55	24:00	31	0.1	107-109	0.058	107-109	0.059
	8:07	24:12	31	0.12	128-130	0.068	128-130	0.068
	8:20	24:25	31	0.18	188-190	0.095	188-190	0.096
	8:32	24:37	31	0.2	205-207	0.103	205-207	0.103
	08:42	24:47	32	0.3	307-309	0.147	307-309	0.148
	08:54	24:59	32	0.4	405-407	0.192	405.5-407.5	0.191
	9:05	25:10	32	0.5	507.5-509.5	0.238	508-510	0.237
	09:17	25:22	32	0.8	806-808	0.367	806-808	0.366
	09:28	25:31	32	1.0	1006-1008	0.448	1006-1008	0.446
	9:40-9:50	25:43	32	2.0	2004-2005	0.812	2003-2005	0.807
	7:30	47:35	30	0.00	voltage without any applied current (ca. 10 mV)			
02.10.24	07:49	47:54	30	0.03	38.5-41	0.025	38.5-41	0.026
	08:09	48:14	30	0.05	56-58	0.034	56-58	0.035
	08:21	48.26	31	0.1	107-109	0.058	107-109	0.058
	08:32	48:37	31	0.12	128-130	0.068	128-130	0.068
	08:43	48:48	31	0.18	188-190	0.095	188-190	0.095
	09:04	49:09	31	0.2	205-207	0.103	205-207	0.103
	09:17	49:22	31	0.3	307-309	0.147	307-309	0.148
	09:28	49:33	31	0.4	405.5-407.5	0.191	405.5-407.5	0.191-0.192
	09:39	49:44	32	0.5	507.5-509.5	0.237	507.5-509.5	0.237
	09:50	49:55	32	0.8	806-807	0.366	807-808	0.366
	10:02	50:07	32	1.0	1006-1008	0.448	1006-1008	0.448
	10:13-10:23	50:18	32	2.0	2005-2006	0.813-815	2003-2005	0.807-809

Analysis

Date	Time	Sample name	Analysis method	Analytical device	Solvent	Raw Data	Processed Data	Data visualization	Comparable Data	Interpretation

04.09	15:00	/	power measurment	Power Meter - 843-R-USB + 919P-020-12	/	see Measurements table above	MRG-059-ZD-evaluation_sheet.xlsx	see below	AE-340: Synthesis of [RuCl2(CO)(PNN)] via [RuCl2(CO)(p-cymene)] AE-341: Power measurment with different power settings from Joy-It with 470 nm	Similar behaviour than AE-340. Not quite linear increase, but more like a power function, therefore fitting with power function seems more adequate. For obtained fitting equations look below



Results/ Conclusions

Generally the power output for all set voltages changed from the first to the second day by 2 to 3 mW for all set voltages below 0.8 V. For the voltages above, the deviation was higher (5-8 mW). This is probably attributable to a slightly changed position of the lamp or sensor, as the sensor needed to be re-inserted to the setup every day. However, for the second and third day, there is even less deviation

Voltages

Measured voltages at beginning and end of 10 min measurement intervals are most of the time the same. If there is a deviation, the deviation is small (range of 1-2 mV). But this was only observed for programmed voltages (set voltage) above 0.8 V.

The output voltages did however, fluctuate in a range of 2 mV. However, this did not seem to have a large influence on the output power as this was constant (within 1 mW) even though the output voltage fluctuated.

Also over the course of three days, the measured voltages for the same programmed voltage did only deviate in a range of maximum 2 mV (in the case of 2 V set voltage).

Temperature of programmable power supply

The temperature of the programmable power supply seems to have a neglectable influence on the output voltage and output power (nearly no deviation in output power between "cold" measurements on first day and "warm" measurements on last day (comparison of power output for measurement for 0.03 - 0.18 V set voltage on first and third day).

Wattages

The standard deviation for the measurements over three days lay in the range of 1 mW for the set voltages up to 0.8 V.

For 1 V and 2 V set voltage, this increases to 2 and 3 mW respectively.

Normed to the output power of the respective set voltage, these are between 0.5 and 2.7% (for set voltages below 0.5 V). Above 0.5 V, the standard deviation shrinks to 0.3 - 0.5%.

Neglecting the deviation between day 1 and day 2/3, all the percentual standard deviations are below 1% (mostly in a range of 0.1 - 0.5%).

General

The deviations in the wattages seem to be in a range up to maximum 3%. If only the values from day 2 and 3 arer taken into account, the deviations are even below 1% for all set voltages. Hence, it seems as if the deviations of the programmable power supply and the resulting deviations in wattages are not responsible for larger deviations in the measurements of the kinetics of the oxygen evloution reactions. The setup can, hence, be utilized as done so far, without the fear of greater inaccuracies due to the longer working time of the programmable power supply over several days.

Linked experiments

- AE-340: Synthesis of [RuCl2(CO)(PNN)] via [RuCl2(CO)(p-cymene)]

- AE-341: Power measurment with different power settings from Joy-It with 470 nm

Photoreactor - AE-339: Radiometry of HP LEDs (405-, 415 and 6500-) using an Ulbrichtkugel I

Linked items

Equipment - Joy-it JT-RD6006 DC POWER SUPPLY

Light Source - UHP LED 470 nm

Power Meter - 843-R-USB + 919P-020-12

Protocol - Irradiation setup

Attached files

MRG-059-ZD-Evaluation_sheet.xlsx
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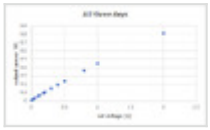

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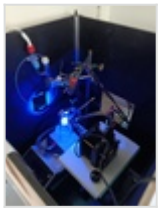

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Link: https://elab.water-splitting.org/experiments.php?mode=view&id=1373