**实　验　报　告** 评分：

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**硅光电池光电特性数据处理**

1. 硅光电池暗伏安特性测量

在没有光照（全黑）下，测量硅光电池正向偏压时*I*-*U*特性曲线。下面是本实验的原始数据。

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 电流表示数/mA | 5.0 | 16.1 | 27.9 | 18.4 | 31.9 | 46.9 | 24.8 | 55.5 | 44.5 | 23.4 |
| 电压表示数/V | 0.6201 | 0.8751 | 1.0711 | 0.9139 | 1.1277 | 1.3324 | 1.022 | 1.4375 | 1.3008 | 0.9979 |
| 电流表示数/mA | 32.2 | 37.0 | 14.2 | 11.5 | 21.8 | 41.0 | 38.9 | 25.3 | 12.6 | 6.5 |
| 电压表示数/V | 1.1362 | 1.2017 | 0.8349 | 0.7758 | 0.9733 | 1.2583 | 1.2248 | 1.0288 | 0.7961 | 0.6592 |

表1 原始数据

由于使用的电流表表盘量程为100 mA，而接入的量程为20 mA，故要进行换算，换算后的数据如下表所示。

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 电流真实测量值/mA | 1.00 | 3.22 | 5.58 | 3.68 | 6.38 | 9.38 | 4.96 | 11.10 | 8.90 | 4.68 |
| 电压真实测量值/V | 0.6201 | 0.8751 | 1.0711 | 0.9139 | 1.1277 | 1.3324 | 1.022 | 1.4375 | 1.3008 | 0.9979 |
| 电流真实测量值/mA | 6.44 | 7.40 | 2.84 | 2.30 | 4.36 | 8.20 | 7.78 | 5.06 | 2.52 | 1.30 |
| 电压真实测量值/V | 1.1362 | 1.2017 | 0.8349 | 0.7758 | 0.9733 | 1.2583 | 1.2248 | 1.0288 | 0.7961 | 0.6592 |

表2 换算后的数据

得到伏安特性曲线如下。



图1 得到的伏安特性曲线

1. 硅光电池输出特性测量

不加偏压，用溴钨灯照射硅光电池，电阻箱为负载。测量不同*L*、*RL*下硅光电池的工作电压*U*，求工作电流*I*和功率*Р*，绘制*I*-*U*、*P*-*RL*曲线。原始数据及所计算的*I*、*P*、*L*在下表中列出。

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *d* = 20 cm  *L* = 250 lx | *RL*/Ω | 50 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 2000 |
| *U*/V | 0.0128 | 0.0515 | 0.0770 | 0.1027 | 0.1271 | 0.1508 | 0.1732 | 0.1944 | 0.2134 | 0.2302 | 0.3210 |
| *I*/mA | 0.2560 | 0.2575 | 0.2567 | 0.2568 | 0.2542 | 0.2513 | 0.2474 | 0.2430 | 0.2371 | 0.2302 | 0.1605 |
| *P*/mW | 0.0033 | 0.0133 | 0.0198 | 0.0264 | 0.0323 | 0.0379 | 0.0429 | 0.0472 | 0.0506 | 0.0530 | 0.0515 |
| *RL*/Ω | 3000 | 4000 | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 | 15000 | 20000 | ∞ |
| *U*/V | 0.3525 | 0.3676 | 0.3763 | 0.3818 | 0.3857 | 0.3885 | 0.3907 | 0.3923 | 0.3977 | 0.4001 | 0.4063 |
| *I*/mA | 0.1175 | 0.0919 | 0.0753 | 0.0636 | 0.0551 | 0.0486 | 0.0434 | 0.0392 | 0.0265 | 0.0200 |  |
| *P*/mW | 0.0414 | 0.0338 | 0.0283 | 0.0243 | 0.0213 | 0.0189 | 0.0170 | 0.0154 | 0.0105 | 0.0080 |  |
| *d* = 30 cm  *L* = 111 lx | *RL*/Ω | 50 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 2000 |
| *U*/V | 0.0084 | 0.0336 | 0.0505 | 0.0673 | 0.084 | 0.1007 | 0.1173 | 0.1337 | 0.1499 | 0.1659 | 0.2854 |
| *I*/mA | 0.1680 | 0.1680 | 0.1683 | 0.1683 | 0.1680 | 0.1678 | 0.1676 | 0.1671 | 0.1666 | 0.1659 | 0.1427 |
| *P*/mW | 0.0014 | 0.0056 | 0.0085 | 0.0113 | 0.0141 | 0.0169 | 0.0197 | 0.0223 | 0.0250 | 0.0275 | 0.0407 |
| *RL*/Ω | 3000 | 4000 | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 | 15000 | 20000 | ∞ |
| *U*/V | 0.3296 | 0.3491 | 0.3600 | 0.3670 | 0.3718 | 0.3754 | 0.3781 | 0.3803 | 0.3867 | 0.3900 | 0.3973 |
| *I*/mA | 0.1099 | 0.0873 | 0.0720 | 0.0612 | 0.0531 | 0.0469 | 0.0420 | 0.0380 | 0.0258 | 0.0195 |  |
| *P*/mW | 0.0362 | 0.0305 | 0.0259 | 0.0224 | 0.0197 | 0.0176 | 0.0159 | 0.0145 | 0.0100 | 0.0076 |  |
| *d* = 40 cm  *L* = 62.5 lx | *RL*/Ω | 50 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 2000 |
| *U*/V | 0.0045 | 0.0186 | 0.0279 | 0.0372 | 0.0465 | 0.0559 | 0.0652 | 0.0744 | 0.0838 | 0.093 | 0.1835 |
| *I*/mA | 0.0900 | 0.0930 | 0.0930 | 0.0930 | 0.0930 | 0.0932 | 0.0931 | 0.0930 | 0.0931 | 0.0930 | 0.0918 |
| *P*/mW | 0.0004 | 0.0017 | 0.0026 | 0.0035 | 0.0043 | 0.0052 | 0.0061 | 0.0069 | 0.0078 | 0.0086 | 0.0168 |
| *RL*/Ω | 3000 | 4000 | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 | 15000 | 20000 | ∞ |
| *U*/V | 0.2593 | 0.3024 | 0.3239 | 0.3363 | 0.3444 | 0.3501 | 0.3543 | 0.3576 | 0.3669 | 0.3713 | 0.3812 |
| *I*/mA | 0.0864 | 0.0756 | 0.0648 | 0.0561 | 0.0492 | 0.0438 | 0.0394 | 0.0358 | 0.0245 | 0.0186 |  |
| *P*/mW | 0.0224 | 0.0229 | 0.0210 | 0.0188 | 0.0169 | 0.0153 | 0.0139 | 0.0128 | 0.0090 | 0.0069 |  |
| *d* = 50 cm  *L* = 40 lx | *RL*/Ω | 50 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 2000 |
| *U*/V | 0.0029 | 0.0118 | 0.0178 | 0.0237 | 0.0296 | 0.0355 | 0.0415 | 0.0473 | 0.0531 | 0.0594 | 0.1179 |
| *I*/mA | 0.0580 | 0.0590 | 0.0593 | 0.0593 | 0.0592 | 0.0592 | 0.0593 | 0.0591 | 0.0590 | 0.0594 | 0.0590 |
| *P*/mW | 0.0002 | 0.0007 | 0.0011 | 0.0014 | 0.0018 | 0.0021 | 0.0025 | 0.0028 | 0.0031 | 0.0035 | 0.0070 |
| *RL*/Ω | 3000 | 4000 | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 | 15000 | 20000 | ∞ |
| *U*/V | 0.1750 | 0.2268 | 0.2676 | 0.2936 | 0.3098 | 0.3202 | 0.3278 | 0.3331 | 0.3476 | 0.3539 | 0.3675 |
| *I*/mA | 0.0583 | 0.0567 | 0.0535 | 0.0489 | 0.0443 | 0.0400 | 0.0364 | 0.0333 | 0.0232 | 0.0177 |  |
| *P*/mW | 0.0102 | 0.0129 | 0.0143 | 0.0144 | 0.0137 | 0.0128 | 0.0119 | 0.0111 | 0.0081 | 0.0063 |  |

表3 原始数据及所要求计算的数据



图2 不同光强下硅光电池工作电流随工作电压变化的图像 图3 不同光强下硅光电池功率随负载的变化图像

1. 硅光电池开路电压与短路电流测量

测量不同光照下硅光电池的开路电压*U*oc、短路电流*I*sc，绘制*U*oc-*L*、*Ⅰ*sc-*L*曲线；给出*U*oc-*L*、*Ⅰ*sc-*L*的近似函数关系。原始数据如下表所示。

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *d*/cm | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| *L*/lx | 250.0 | 160.0 | 111.1 | 81.6 | 62.5 | 49.4 | 40.0 |
| *U*oc/V | 0.4093 | 0.4084 | 0.3993 | 0.3903 | 0.3826 | 0.3753 | 0.3690 |
| 测电流时电压表示数/V | 0.0146 | 0.0127 | 0.0089 | 0.0066 | 0.0047 | 0.0036 | 0.0029 |

表4 原始数据

根据表4中的电压表示数，结合做实验时恒定电阻*R*＝50Ω，可计算短路电流值如下表所示。

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *d*/cm | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| *L*/lx | 250.0 | 160.0 | 111.1 | 81.6 | 62.5 | 49.4 | 40.0 |
| *U*oc/V | 0.4093 | 0.4084 | 0.3993 | 0.3903 | 0.3826 | 0.3753 | 0.3690 |
| *I*sc/mA | 0.292 | 0.254 | 0.178 | 0.132 | 0.094 | 0.072 | 0.058 |

表5 处理后的数据

 

图4 得到的*U*oc-*L*图线 图5 得到的*I*sc-*L*图线

1. 不同负载下硅光电池输出电压与光照测量

测量不同负载*RL*的硅光电池输出电压*U*与光照度*L*的关系，绘制*U-L*曲线并分析负载对*U-L*的影响。原始数据及计算得到的*U-L*曲线如下。

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | *d*/cm | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| 100Ω | *L*/lx | 250 | 160 | 111.1 | 81.6 | 62.5 | 49.4 | 40.0 |
| *U*/V | 0.0266 | 0.0238 | 0.0167 | 0.0124 | 0.0093 | 0.0072 | 0.0059 |
| 1000Ω | *L*/lx | 250 | 160 | 111.1 | 81.6 | 62.5 | 49.4 | 40 |
| *U*/V | 0.2311 | 0.2187 | 0.1653 | 0.1216 | 0.0928 | 0.0733 | 0.0586 |
| 5000Ω | *L*/lx | 250 | 160 | 111.1 | 81.6 | 62.5 | 49.4 | 40 |
| *U*/V | 0.377 | 0.3746 | 0.3597 | 0.3412 | 0.3227 | 0.2967 | 0.2659 |
| 10000Ω | *L*/lx | 250 | 160 | 111.1 | 81.6 | 62.5 | 49.4 | 40 |
| *U*/V | 0.3952 | 0.3914 | 0.3793 | 0.3676 | 0.3556 | 0.3429 | 0.3311 |

表6 原始数据



图6 不同负载下得到的*U*-*L*图线

可以看到，负载越大，在同一光照度下硅光电池的输出电压也越大。而且当负载越小时，负载变化对输出电压的变化影响越大。