## 数据处理与结果

使用本套实验系统，选用被测样品为直径0.3mm~1.0mm铜丝、直径0.6mm碳钢丝、直径0.6mm铁丝，在不同温度条件下测量杨氏模量。以测量铜丝在不同温度下的杨氏模量为例。实验过程中分别测得温度T，金属丝直径D，金属丝长度L，拉力F及对应形变量ΔL，多次测量后求出对应斜率，取平均值。根据公式求出对应温度下铜丝的杨氏模量。

### 不同温度下杨氏模量测量结果

条件：g = 9.78m/s2；T = 289.7K；D = 0.966mm；L = 42.37cm

图表1 伸长量与拉力关系数据记录表

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L/10-2mm | 0.1 | 2.5 | 5.2 | 7.8 | 10.1 | 12.9 | 16.4 | 17.6 | 20.6 | 22.7 |
| m/kg | 25.5 | 26.0 | 26.5 | 27.0 | 27.5 | 28.0 | 28.5 | 29.0 | 29.5 | 30.0 |

代入上述值，求出杨氏模量

条件：g = 9.78m/s2；T = 310.3K；D = 0.581mm；L = 41.92cm

图表2 伸长量与拉力关系数据记录表

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L/10-2mm | 126.6 | 132.2 | 139.2 | 144.7 | 152.0 | 162.0 | 167.3 | 173.5 | 182.1 | 185.3 |
| m/kg | 15.0 | 15.5 | 16.0 | 16.5 | 17.0 | 17.5 | 18.0 | 18.5 | 19.0 | 19.5 |

代入上述值，求出杨氏模量

铜丝直径D：

条件：g = 9.78m/s2；T = 339.6K；D = 0.964mm；L = 42.55cm

图表3 伸长量与拉力关系数据记录表

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L/10-2mm | 27.0 | 29.5 | 33.2 | 35.4 | 37.5 | 39.9 | 42.6 | 45.3 | 47.4 | 50.1 |
| m/kg | 25.0 | 25.5 | 26.0 | 26.5 | 27.0 | 27.5 | 28.0 | 28.5 | 29.0 | 29.5 |

代入上述值，求出杨氏模量

条件：g = 9.78m/s2；T = 390.2K；D = 0.592mm；L = 42.14cm

图表4 伸长量与拉力关系数据记录表

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L/10-2mm | 16.0 | 23.5 | 28.2 | 32.0 | 40.1 | 46.1 | 54.4 | 62.7 | 70.8 |
| m/kg | 15 | 15.5 | 16 | 16.5 | 17 | 17.5 | 18 | 18.5 | 19 |

代入上述值，求出杨氏模量

条件：g = 9.78m/s2；T = 430.6K；D = 0.984mm；L = 42.47cm

图表5 伸长量与拉力关系数据记录表

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L/10-2mm | 44.1 | 47.6 | 50.1 | 51.6 | 53.6 | 57.1 | 59.4 | 62.0 | 65.8 | 68.0 |
| m/kg | 25 | 25.5 | 26 | 26.5 | 27 | 27.5 | 28 | 28.5 | 29 | 29.5 |

代入上述值，求出杨氏模量

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| L/10-2mm | 126.6 | 132.2 | 139.2 | 144.7 | 152.0 |
| m/kg | 15.0 | 15.5 | 16.0 | 16.5 | 17.0 |
| L/10-2mm | 162.0 | 167.3 | 173.5 | 182.1 | 185.3 |
| m/kg | 17.5 | 18.0 | 18.5 | 19.0 | 19.5 |

条件：g = 9.78m/s2；T = 430.6K；D = 0.976mm；L = 42.13cm

图表6 伸长量与拉力关系数据记录表

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L/10-2mm | 38.2 | 40.1 | 43.6 | 46.7 | 49.0 | 51.6 | 54.4 | 57.0 | 60.1 | 62.8 | 65.0 |
| m/kg | 25 | 25.5 | 26 | 26.5 | 27 | 27.5 | 28 | 28.5 | 29 | 29.5 | 30 |

代入上述值，求出杨氏模量

### 实验结论

查阅书籍资料，铜及其合金的杨氏模量为0.73~1.27×1011Pa，可以看到本次实验测得铜丝杨氏模量基本在铜丝的杨氏模量范围以内。证明本实验装置测量杨氏模量可行。实验过程中，同一温度下不同材料的杨氏模量基本一致。证明对于使用不同直径的铜丝引入的材料误差是基本可以忽略不计的。

在不同的温度条件下，同一类型材料金属丝的杨氏模量测定结果不同。温度较低时，杨氏模量随着温度的升高无明显变化。升温到一定程度时，铜丝的杨氏模量随着温度的上升呈下降趋势。

### 误差分析

（写不写待定）

①铜丝准直（是否全为弹性形变）

②测温仪：仪器误差

③显微镜误差（仪器误差+测量误差）

④（主要）电热炉：加热不均匀

⑤长度忽略不计：系统误差

⑥桌面形变

⑦力传感器：仪器误差，存在摩擦

⑧铜丝：材质不均匀，超过弹性形变。

⑨多次测量：材料引入的误差