(PM1-5) Young`s Modulus for a Metallic Wire

Aim of experiment

Determination of Young's modulus of a wire by measuring the longitudinal stress and strain of the wire.

Apparatus

Holder with Clamp for Fixing the Wire- Metal Thin Wie -Dial Micrometer- Different Weights

Theory of experiment

Young's modulus of a wire, Y, is a measure of the elasticity of that wire, i.e. the ability of a wire to restore to its initial length after removing the force applied to it.

Young's modulus (Y) of a string of Original length *L*, and Cross-sectional area A, when applying an extension force *F=Mg* in the elastic limit where *M* is loaded mass and g is the acceleration due gravity , is defined mathematically as

$$Y = \frac{\text{Sress}}{\text{Strain}}$$

$$Stress = \frac{Applied\ Force}{Cross\ sectional\ Area\ of\ the\ wire} = \frac{F}{A}$$

$$Strain = \frac{Wire\ extension}{Original\ length} = \frac{\Delta L}{L}$$

$$Y = \frac{\frac{F}{A}}{\frac{\Delta L}{L}}\ N/m^2$$

If loaded within the limits of perfect elasticity the graph of extension against load will be a straight line between A and B, shown in the graph, thus verifying Hook's Law. On unloading,

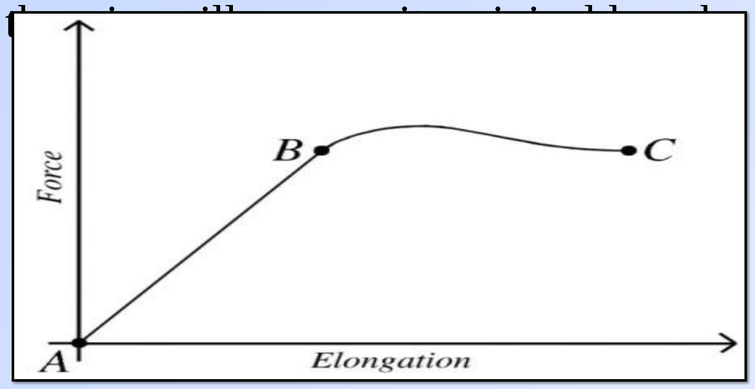

Figure 1 A typical force-elongation diagram

Further loading beyond the elastic limit, B, will result in much larger relative extensions, and on removing the weights the wire will be found to have acquired a 'permanent set', between B and C. Further loading beyond point C will result in wire breaking. The stress is then called the breaking strength, *figure 1.*

Procedures

1. Fix one end of the wire to the holder, and the other end to the pan
2. connect the pan with the micrometer dial
3. Measure the length and the diameter of the wire
4. Add weights gradually to the pan and for every weight, measure the elongation occurred by taking the reading of the dial.
5. Remove weights and try again 2 more times.
6. Tabulate your results .
7. Plot a graph between mass, *M*, and average elongation, ΔL_{av}.
8. From the slope, find Young's modulus,

$$Y = \frac{1}{slope} \times \frac{gL}{A}$$

Results

The wire initial length is $L=$ *m*

A (area of the wire) = m^2 *and*

$g = 9.83\ m/s^2$

Trial / *M (kg)*	*1* / ΔL_1	*2* / ΔL_2	*3* / ΔL_3	ΔL_{av}

Slope=

Y=

Figure 2 A simple Young's modulus apparatus

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