The determination of copper in brass

Objective

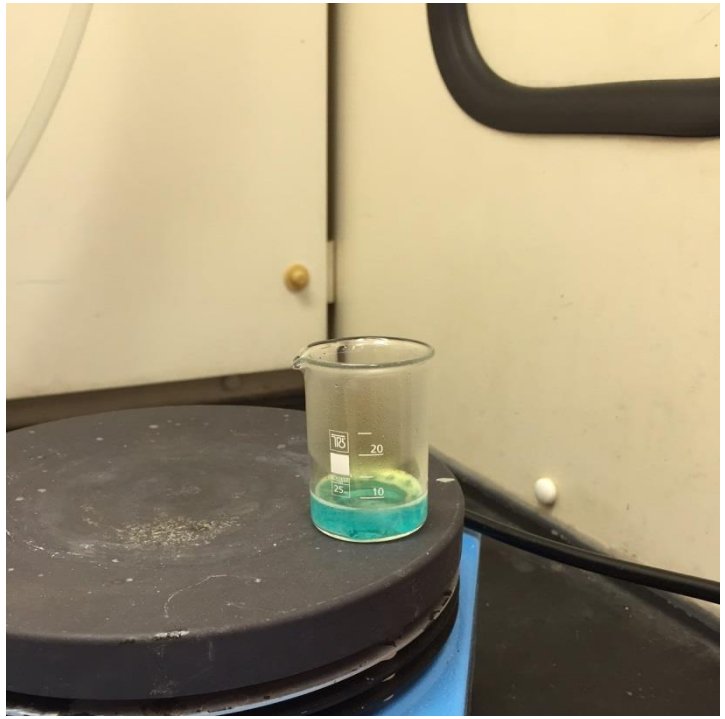
- To determine the amount of copper in a brass sample

Chemical reactions

$3Zn + 2NO_3^- + 8H^+ \rightarrow 3Zn^{2+} + 2NO + 4H_2O$

$3Cu + 2NO_3^- + 8H^+ \rightarrow 3Cu^{2+} + 2NO + 4H_2O$

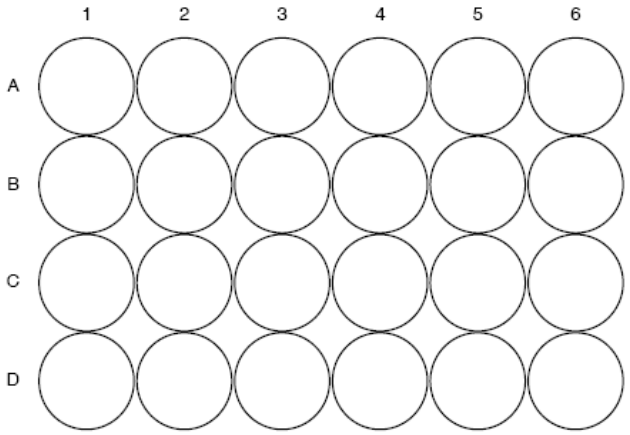
$2NO + O_2 \rightarrow 2NO_2$

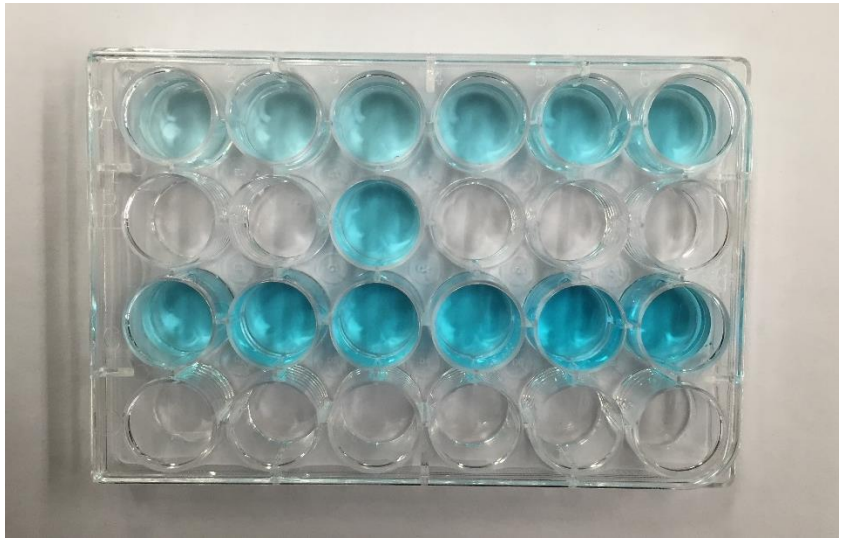


The determination of copper in brass

(A) Microscale method

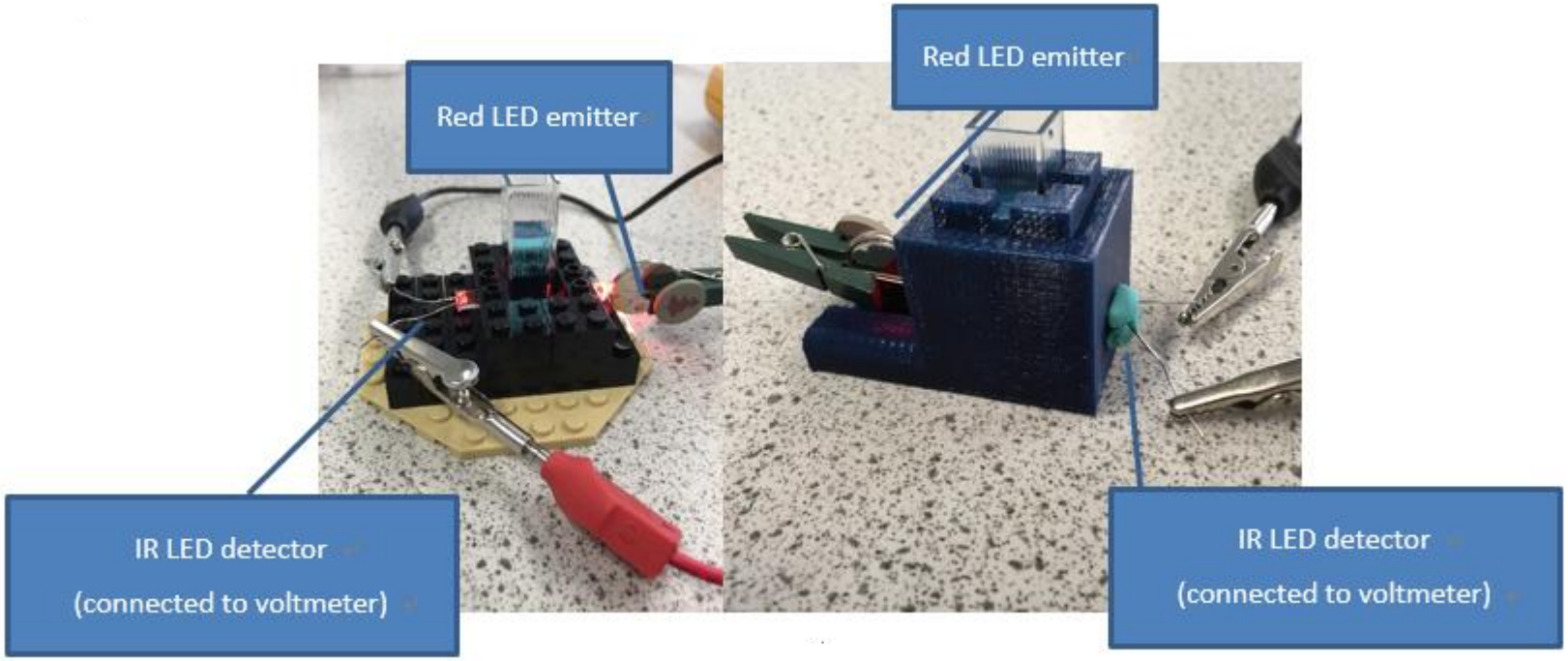
Well No	A1	A2	A3	A4	A5	A6	C1	C2	C3	C4	C5	C6
Drops of 0.50 mol dm^{-3} copper nitrate solution	8	10	12	14	16	18	20	22	24	26	28	30
Drops of water	32	30	28	26	24	22	20	18	16	14	12	10





The determination of copper in brass

(B) Instrumental method



The determination of copper in brass

Relative absorbance = $\log_{10}(V_0 / V_s)$

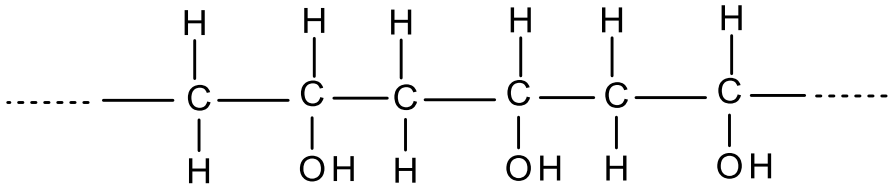
where V_0 is the voltage reading with a cuvette containing just deionised water
V_s is the voltage reading with a sample in the cuvette

	Deionised water	0.1 M $CuSO_4(aq)$	0.2 M $CuSO_4(aq)$	0.3 M $CuSO_4(aq)$	0.4 M $CuSO_4(aq)$	0.5 M $CuSO_4(aq)$	Sample solution
Voltage reading / V							
Relative absorbance							

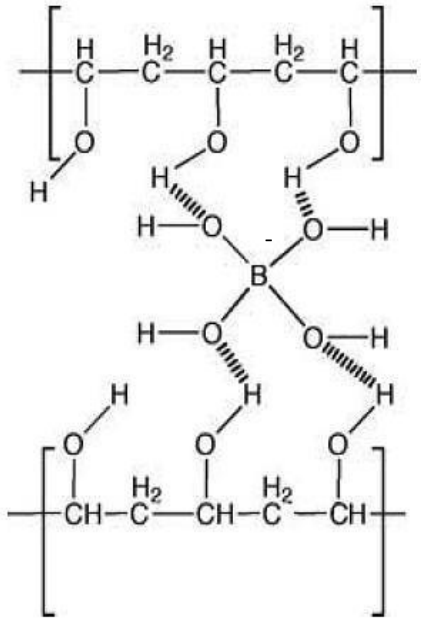
Preparation of “Slime”

$$H_3BO_3 + H_2O \rightleftharpoons B(OH)_4^- + H^+$$

Boric acid



PVA



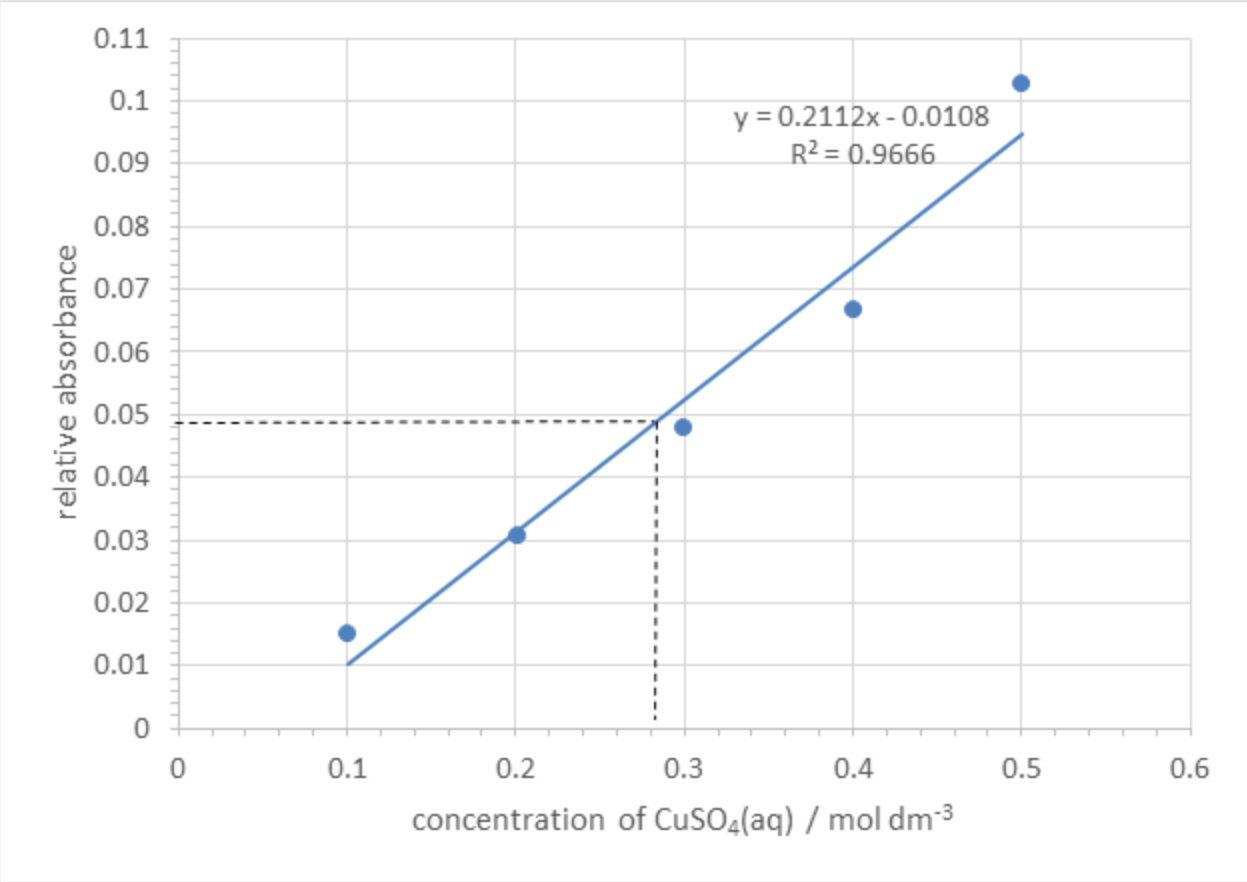
Slime

Teachers' notes

- The determination of copper in brass
- Preparation of "Slime"

The determination of copper in brass

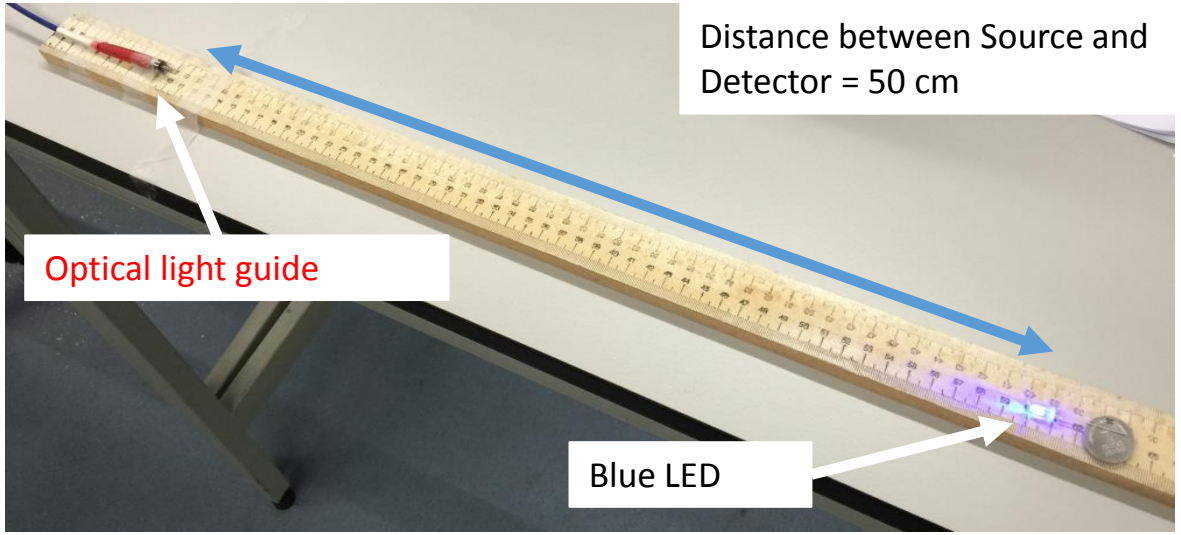
- Instrumental method

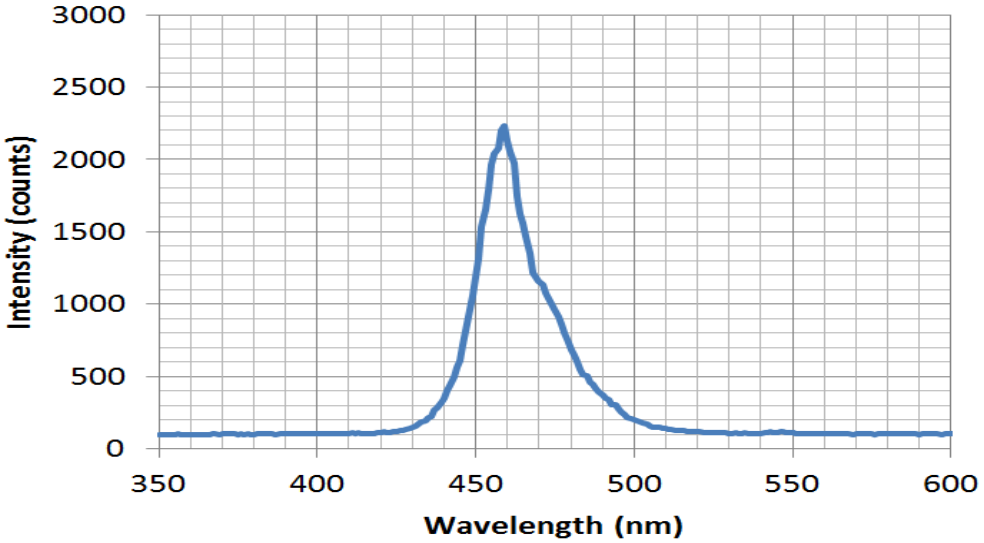


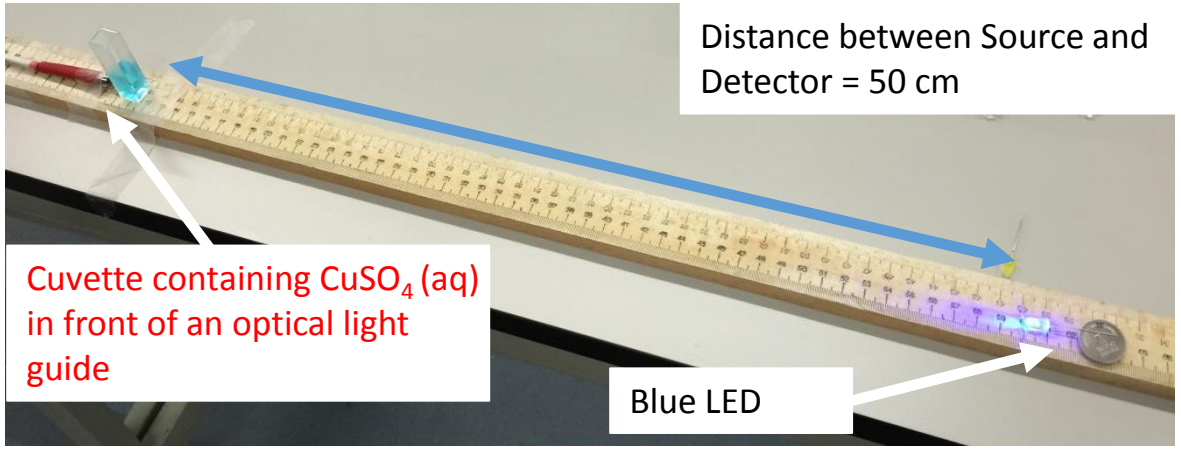
Conc. of sample $CuSO_4(aq)$ = 0.281 M

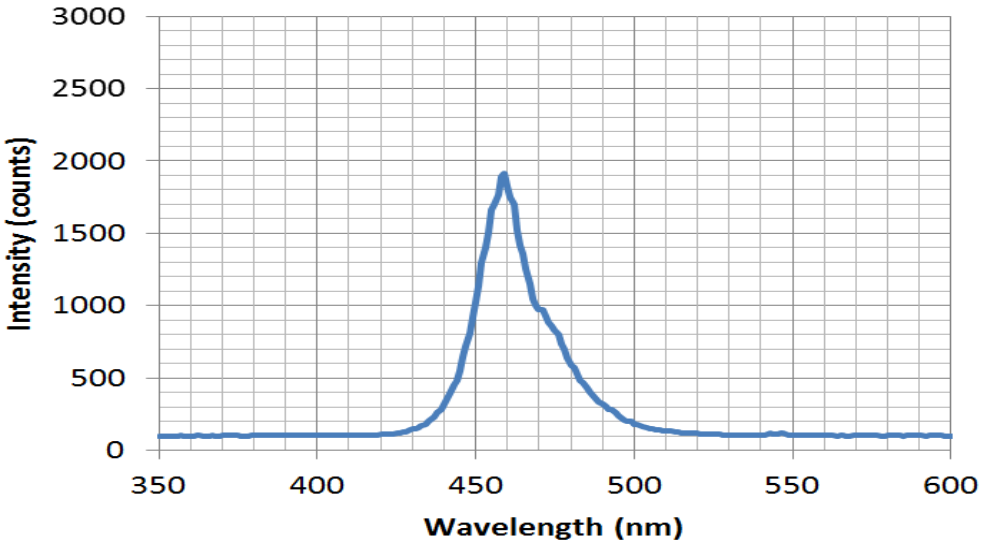
➔ Mass of Cu in brass solution = 0.178 g

➔ % by mass of Cu in brass sample = 59.3%

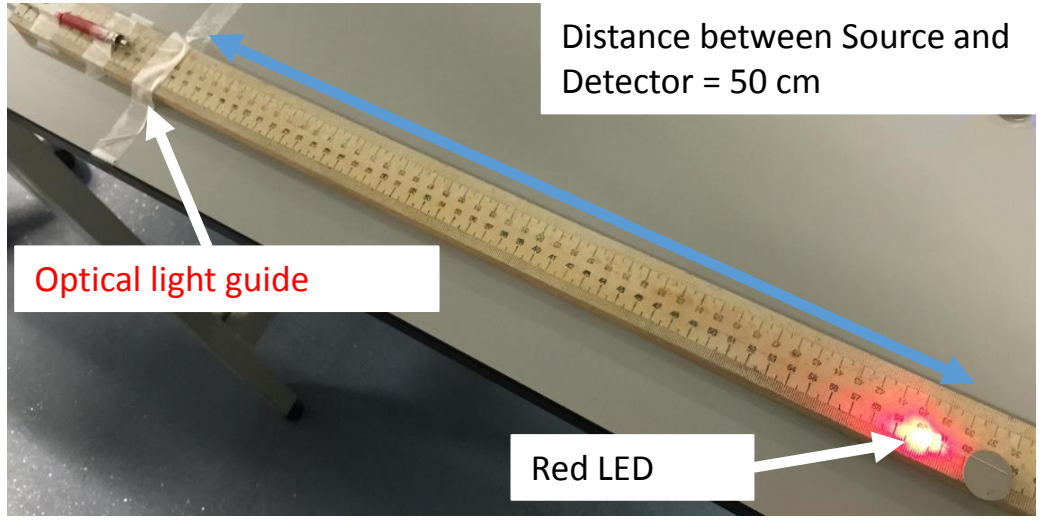


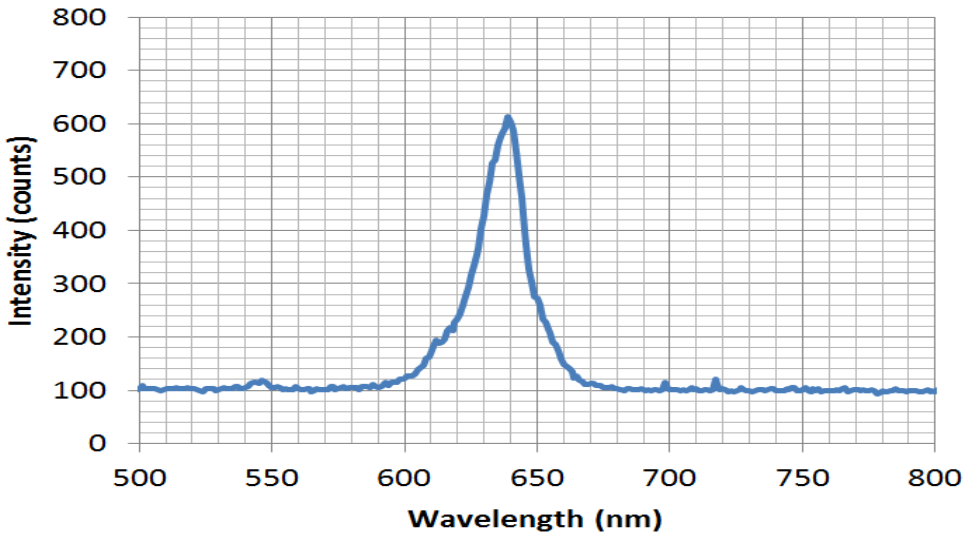


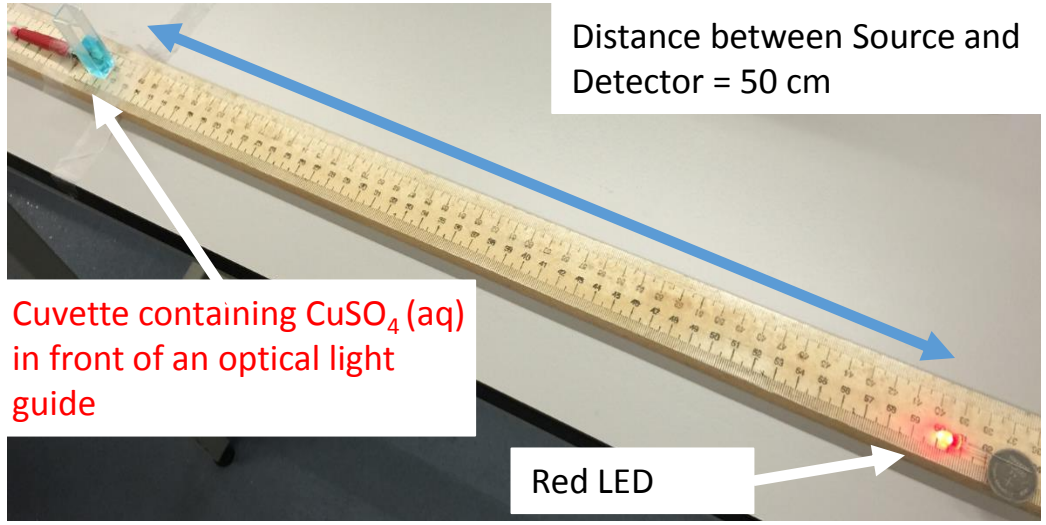


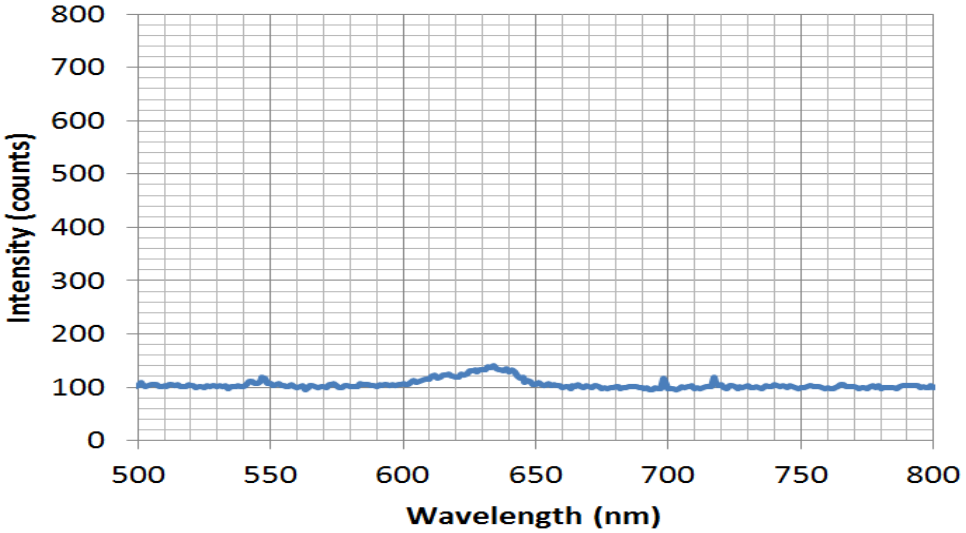


- Blue LED gives peak intensity at 450 - 470 nm
- The peak intensities of the two setups are similar, i.e. no significant blue light absorption is found in $CuSO_4$ solution









- Red LED gives peak intensity at 620 - 650 nm
- The peak intensity of the setup with cuvette is significantly lower, i.e. strong red light absorption is found in $CuSO_4$ solution

The LED colorimeter

- The voltage produced by the detector LED may not be directly proportional to the light intensity shining on the LED
- The Beer Lambert law does not apply if there is more than one colour change in the reaction
- The detector LED may be saturated in very bright light

The Beer-Lambert Law

$A = \varepsilon \, l \, c$

(A = absorbance; l = length of light; c = conc. of pigment; ε = constant)

$A \propto \log_{10} (V_o / V_s)$

Where

V_o = voltage for blank solution

Vs = voltage for sample solution

Preparation of "Slime"

Preparation of:

4% PVA

960 cm^3 of D. I. water + 40 g high M.W. PVA with stirring

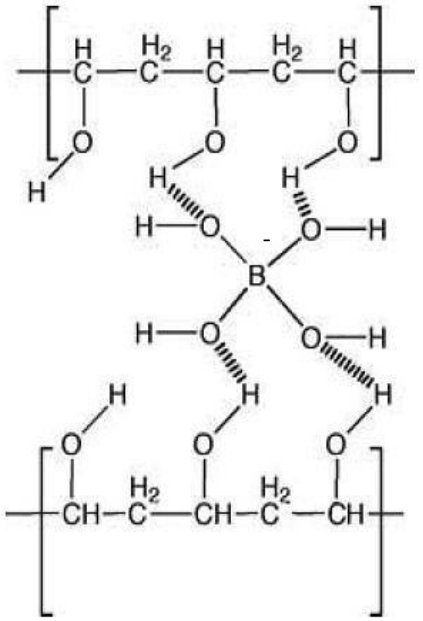
4% sodium tetraborate

solid borax ($Na_2B_4O_7 \cdot 10H_2O$) dissolve in D. I. water to make

4% by weight sodium tetraborate

Preparation of “Slime”

- The slime can adhere water-soluble ink



H-bond Cross-linkages

Deformation of cross-linkage network through pouring, squeezing…

https://drive.google.com/open?id=0BzCEkXNdGw3SR3lXd0RlWmNEVk0