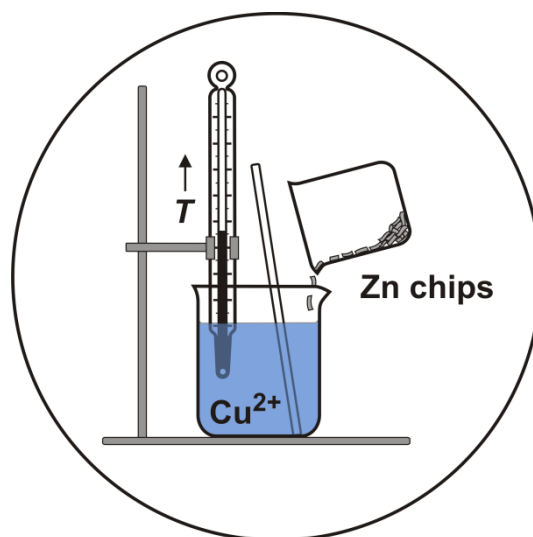


Reduction of Cu^{2+} ions by Zinc

—short-circuited DANIELL Element



Equipment:

high form glass beaker (250 mL)
glass beaker (100 mL)
glass rod
demonstration thermometer (0 bis 100°C)
ring stand, bosshead, extension clamp

Chemicals:

saturated copper sulfate solution (i.e. about 260 g
of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in 740 mL Wasser)
zinc cuttings

Safety:

copper(II) sulfate pentahydrate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$):



H302, H315, H319, H410
P273, P305 + P351 + P338, P302 + P352

zinc chips (Zn):



H410
P273

It is required to wear safety glasses and protective gloves; if possible, the experiment should be carried out in a fume hood.

Procedure:

Preparation: 250 mL of copper sulfate solution is placed in the high form beaker. The demonstration thermometer is fixed with the clamp in such a way that it dips well into the solution. 18 g of zinc chips are provided in the small beaker. The chips should be shorter than 1 cm so that the mixture can be stirred more easily; chips that are too long should therefore be cut into smaller pieces.

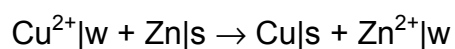
Procedure: The zinc chips are poured into the copper sulfate solution and the mixture is then stirred vigorously.

Observation:

The zinc chips immediately turn black and form a precipitate, which becomes rapidly more dense. The precipitate slowly turns copper brown. Within 3 minutes, the temperature rises above 60 ° C and the solution “fumes” slightly. The solution initially blue in color becomes green, brown and finally colorless.

Explanation:

If zinc chips are added to the solution containing Cu(II), according to the conversion formula



Cu^{2+} will be reduced to Cu, while Zn will be oxidized to Zn^{2+} , because according to the levels of the electron potentials [$\mu_e^\ominus(\text{Zn}/\text{Zn}^{2+}) = +65.5 \text{ kG} > \mu_e^\ominus(\text{Cu}/\text{Cu}^{2+}) = -174 \text{ kG}$] the redox pair Zn/Zn^{2+} is more strongly reducing than the redox pair Cu/Cu^{2+} .

Disposal:

The solution is poured in a special jar for heavy metal waste disposal.