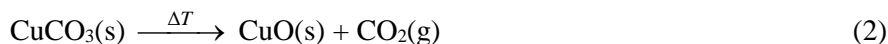
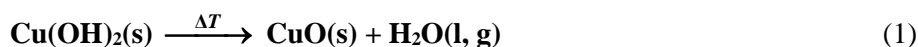


Preparation of copper(II) oxide

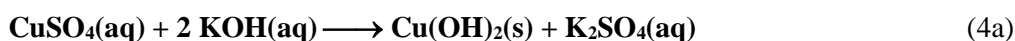
Copper(II) oxide is a black powdered substance, insoluble in common solvents. It is the starting compounds for preparation of copper(II) salts by the reactions with strong acids. Copper(II) oxide can be easily prepared by thermal decomposition,



or by annealing of metallic copper in air oxygen.



Reaction (1) occurs readily also in boiling aqueous suspensions of copper(II) hydroxide, which can be prepared by the precipitation reaction of soluble copper(II) salt with strong alkali hydroxide.



Copper(II) oxide can be reduced back to copper by heating in hydrogen atmosphere. At higher temperatures decomposes to form copper(I) oxide and oxygen. Very pure copper(II) oxide is used for preparation of high-temperature superconductors of general formula $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$.

Work

Prepare 2,0 g of copper(II) oxide by thermal decomposition of precipitated copper(II) hydroxide.

Chemicals

- copper(II) sulphate pentahydrate, $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$, light blue crystalline
- potassium hydroxide, KOH, white crystalline, granules or flakes

Procedure

Prepare the 3 % aqueous solution from the calculated amount of copper(II) sulphate pentahydrate. Under continuous stirring add slowly the calculated volume of slightly warm 10 % aqueous solution of potassium hydroxide. Immediately the deep blue copper(II) hydroxide precipitates. Check with the litmus paper if pH is strongly basic ($\text{pH} > 12$). If not, add small excess of hydroxide. Heat the beaker to the boil for *cca* 30 minutes, until its content is completely turned to black suspension without any traces of blue colour. Stir the suspension during heating (see note ❶ below). If too much water was evaporated, replenish it. Then stop heating, let the suspension stand for few minutes to settle at the bottom and purify it by the decantation (see note ❷ below). Filter black copper(II) oxide out on the Büchner funnel (see note ❸ below), wash it by water, and put it into an oven heated over 105 °C.

Notes

❶ Precipitated copper(II) oxide forms a thick layer on the bottom of a beaker which prevents bubbles of boiling water from moving up, what is hazardous and causes the important loss of product (see the following links).

[CuO_1213_28.jpg](#) [CuO_1213_29.jpg](#) [CuO_1213_30.jpg](#)

To avoid this, the layer of copper(II) oxide should be as thin as possible. Therefore, use the widest beaker and stir the suspension continuously with a glass rod.

❷ **Decantation** is a laboratory operation for purification of the precipitated substance. Let stand the suspension in a beaker until it settles. The clear liquor over the precipitate remove slowly by the capillary connected to the source of vacuum. Then add another portion of pure solvent (water), stir the suspension rigorously and let it settle again. Repeat these steps two or three times.

❸ Copper(II) oxide is extremely poorly soluble in water (solubility constant = $4,47 \cdot 10^{-21}$), what makes the solution over the precipitate colourless and transparent. Any black particles visible in the solution are the evidence that the filter is not tight enough.

Safety instructions

Copper(II) sulfate pentahydrate – CuSO₄ · 5H₂O

- R22** Harmful if swallowed.
- R36/38** Irritating to eyes and skin.
- S22** Do not breathe dust

Potassium hydroxide – KOH

- R35** Causes severe burns.
- S26** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
- S37/39** Wear suitable gloves and eye/face protection.

Copper(II) oxide – CuO

- R20/22** Harmful by inhalation and if swallowed.
- R36/37/38** Irritating to eyes, respiratory system and skin.
- S26** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
- S36** Wear suitable protective clothing