Preparation of $[\text{Cu(NH}_3\text{)}_4\text{]}\text{SO}_4 \cdot \text{H}_2\text{O}$

From a solution containing copper(II) ions insoluble basic salts can be precipitated by the action of ammonium-hydroxide. The light blue precipitate dissolves in the excess of $\text{NH}_4\text{OH}$, forming dark blue $[\text{Cu(NH}_3\text{)}_4\text{]}^{2+}$ complex ions. Reacting copper(II)sulfate with excess ammonium-hydroxide results in a dark blue solution, from which $[\text{Cu(NH}_3\text{)}_4\text{]}\text{SO}_4 \cdot \text{H}_2\text{O}$ can be crystallized.

\[
2\text{ CuSO}_4(\text{aq}) + 2\text{ NH}_4\text{OH}(\text{aq}) = \text{Cu}_2(\text{OH})_2\text{SO}_4(\text{s}) + (\text{NH}_4)_2\text{SO}_4(\text{aq}) \\
\text{Cu}_2(\text{OH})_2\text{SO}_4(\text{s}) + (\text{NH}_4)_2\text{SO}_4(\text{aq}) + 6\text{ NH}_4\text{OH}(\text{aq}) = 2[\text{Cu(NH}_3\text{)}_4\text{]}\text{SO}_4(\text{aq}) + 8\text{ H}_2\text{O(1)}
\]

Grind 6.2g $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in a mortar and add it to the solution of 15 cm$^3$ concentrated ammonium-hydroxide and 10 cm$^3$ water. In order to decrease the solubility add 15 cm$^3$ methanol to the solution slowly while stirring. The solution is stored for three hours in a cool place. The formed dark blue crystals are separated on a glass filter and washed with 25 cm$^3$ of 1:1 mixture of methanol and cc $\text{NH}_4\text{OH}$. Finally the crystals are rinsed with methanol and dried in air stream. Since methanol is flammable, avoid working close to a flame.

$[\text{Cu(NH}_3\text{)}_4\text{]}\text{SO}_4 \cdot \text{H}_2\text{O}$