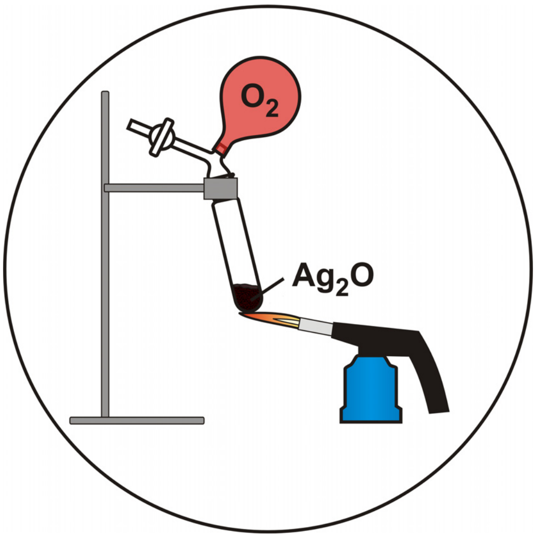
Annealing of Silver Oxide



Equipment:

glass equipment with high-melting test tube and ground-glass joint (see figure on the right)
small balloon
ring stand, clamp
water jet pump
burner
wooden splint

Chemicals:

silver oxide

Safety:

silver oxide (Ag_2O): O, C   R8-34-44   S26-36/37/39-45

 O    C

It is necessary to wear safety glasses and protective gloves.

Procedure:

Preparation: Approx. 2 g silver oxide are filled in the test tube and the balloon is put over the top part (as in the figure above). The whole equipment is mounted and clamped on the stand. It is then evacuated by a water jet pump.
Procedure: The blackish brown silver oxide is moderately heated by a burner, until the whole oxide was decomposed.

Observation:

The substance gradually changes its colour to whitish. The generation of a gas is detectable by the slow blowing up of the balloon. Subsequently, the gas can be identified as oxygen with a glowing splint. White shiny silver metal remains in the test tube.

In a simplified version of the experiment silver oxide can be filled in a normal high-melting test tube and heated. The glowing splint is then placed directly into the mouth of the test tube.

Explanation:

The thermal decomposition of silver oxide can be described by:

$$2\ Ag_2O|s \rightarrow 4\ Ag|s + O_2|g$$

$\Sigma\mu^{\ominus}$: −22.6 < 0

⇨ chemical drive $\mathcal{A}^{\ominus}$: −22.6 kG

The decomposition does not take place at room temperature due to the negative drive. However, since a gas, that means a substance with strongly negative temperature coefficient α, should be formed we expect that this process will begin at a high enough temperature.

Substance	Chemical potential $\mu^{\ominus}$ [kG]	Temperature coeffizient α [G/K]
$Ag_2O|s$	–11.3	–121
$Ag|s$	0	–43
$O_2|g$	0	–205

The minimum temperature T_D for the decomposition of Ag_2O is obtained from the condition that the combined chemical potentials of the initial and final substances must be equal and the chemical drive $\mathcal{A}$ changes its sign:

$$\mathcal{A} = \mathcal{A}_0 + \alpha \cdot (T_D - T_0) = 0\,.$$

We obtain

$$T_D = T_0 - \frac{\mathcal{A}_0}{\alpha}.$$

Inserting the $\mathcal{A}^{\ominus}$ and α values which are calculated according to $\alpha = 2 \cdot \alpha_{Ag_2O} - 4 \cdot \alpha_{Ag} - \alpha_{O_2}$ results in $T_D \approx 465$ K.

Disposal:

The silver residue is collected for reworking in a special container.