Aqueous Synthesis of Thiol-Capped CdTe Nanocrystals: State-of-the-Art

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Supporting Information

Electrochemical generation of H_2Te gas used for the synthesis of CdTe nanocrystals

In our experiments the hydrogen telluride was produced by electrochemical reduction of a tellurium electrode in the electrochemical cell at room temperature according to the following reaction:

$$Te^0 + 2H^+ + 2e^- \rightarrow H_2Te\uparrow \qquad E_0 = -0.51V \text{ [1]}$$

The electrochemical cell was equipped with a Te cathode and a Pt anode. The anode compartment was separated from the cell by a porous glass membrane. 50 wt % solution of the H_3PO_4 was used as the electrolyte. Figure S1 shows the details of the experimental setup.

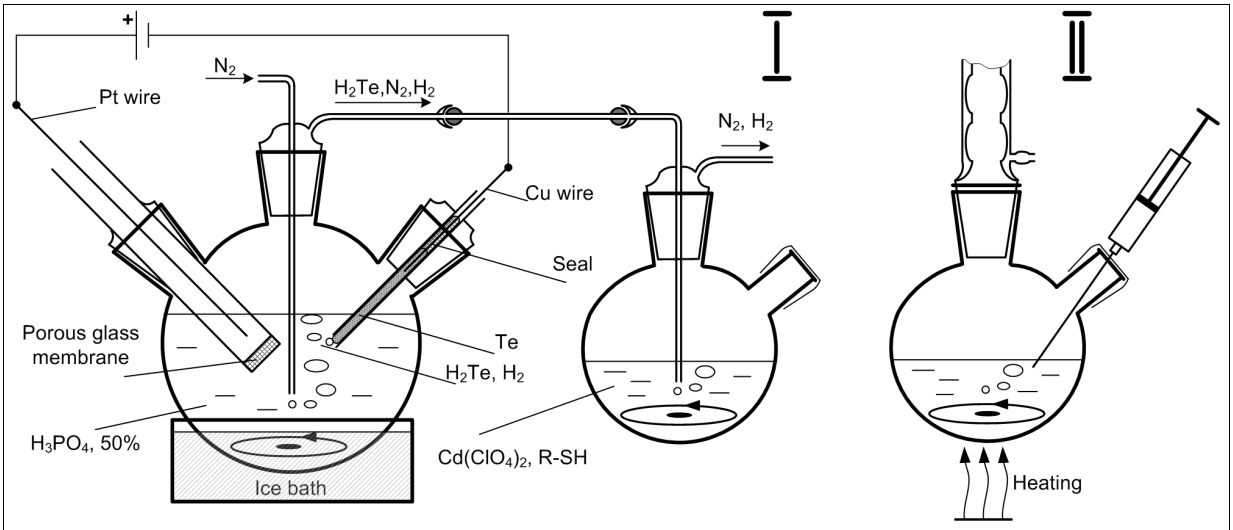

Figure S1. Experimental setup for electrochemical synthesis of the H_2Te.

The Te electrode was prepared as follows: Tellurium lumps (powder, Fluka) were placed in the glass tube and melted. A Pt contact wire was placed in the liquid tellurium. After cooling to room temperature, the empty part of the tube was sealed by epoxy resin and the glass end of tube was carefully broken providing a "naked" Te-surface.

Refs. [2,3,4] use this reaction at low temperature (-5C° to -10C°) in order to avoid decomposition of the H_2Te gas. At the current density used (380 mA/cm^2) and at room temperature we did not find this effect to be significant.

In order to calculate the amount of H_2Te one may use following equation:

$$\nu = I\, t\, \eta / 2\, F$$

(I - current strength, F = 96484.56: Faraday constant, η - electrochemical efficiency, t - duration of the experiment).

In order to estimate the effectiveness of our cell the followed experiment was carried out: 100 ml of cadmium nitrate solution (0.04 M) was placed in a three-necked flask fitted with a septum and valves and was de-aerated by Ar bubbling for 1.0 hours. The desired amount of H_2Te gas was passed through the solution, controlled by the duration of electrolysis (at 380 mA/cm^2 current strength). In order to remove all dissolved H_2Te gas, the flow of Ar was maintained for 30 additional minutes. The precipitate of CdTe was filtered out, washed with bi-distilled water, dried and weighed. The efficiency of our cell was 35% which is less than was published by Hodes for 50% H_2SO_4 electrolyte [4]. Altering the electrochemical efficiency during long term

use of the Te electrode can not be excluded [4]. Thus, periodic calibration of the electrochemical efficiency of the cell is necessary.

References

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