Properties of matter - sublimation

Physics	Thermodynamics	States of matter, dissolution (kinetic particle theory)
Chemistry	General Chemistry	States of matter, dissolution (kinetic particle theory)

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/5f517d85739d0a0003ee4086

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
www.phywe.de

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Teacher information

Application

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Experiment set-up

In chemistry lessons, students learn about the three classical forms of state (solid, liquid, gaseous). Certain substances change directly from the solid to the gaseous state without liquefying. This process or its reversal is called sublimation or resublimation.

Application examples are dry ice (sublimation), where the frozen, solid carbon dioxide becomes gaseous when heated without melting. Further applications are the freeze-drying of food (e.g. dried yeast, instant coffee) or the sublimation of iodine.

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Other teacher information (1/2)

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Prior knowledge

The students should be familiar with the states of matter (states of aggregation) and their transitions. Typically, solid materials become liquid when heated and change to the gaseous state (when heated further). Nevertheless, there are substances that change directly from the solid state to the gaseous state when heated (e.g. carbon dioxide)

Scientific principle

Benzoic acid is used in this experiment. At room temperature, benzoic acid is present in a solid state, and heating causes the substance to change to a gaseous state (= sublimation). After cooling, benzoic acid changes its aggregate state again (= resublimation) and becomes solid.

Other teacher information (2/2)

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Learning objective

In this experiment, the students observe that substances can also change directly from the solid state to the gaseous state when heated. This transition of a substance from the solid to the gaseous state without becoming liquid is called sublimation. The reverse process, from the gaseous to the solid state, is called resublimation.

Tasks

Using benzoic acid as an example, the process of sublimation or resublimation is examined in this experiment. The changes of benzoic acid during heating/cooling are observed.

The terms sublimation/resublimation are usually not familiar to students and must be introduced in the classroom. Only then is it possible to carry out a meaningful experiment.

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Safety instructions

Dangers

- Benzoic acid is irritating to the eyes. Avoid contact with eyes!
- Put on protective goggles!
- Ventilate the room well after the experiment!

Methodological comments

For this experiment the general instructions for safe experimentation in science lessons apply. Make sure that the students keep the burner flame as small as possible and work with the smallest possible amount of benzoic acid.

Disposal

The benzoic acid in the beaker can be dissolved in acetone and then added to the collection container for combustible organic substances.

Student Information

Robert-Bosch-Breite 10
37079 Göttingen

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info@phywe.de
www.phywe.de

Motivation

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Winter in Thuringia 2010

Everyone knows the classic states of matter (solid, liquid, gaseous) as well as the transitions between the states of matter. Normally, solid substances change first into the liquid and then into the gaseous state when heated.

But can substances change from the solid state of aggregation directly into the gaseous state?

In this experiment you will investigate how the states of aggregation change during heating and how benzoic acid changes directly from the solid state to the gaseous state during heating.

Tasks

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Is it possible to change a solid directly from the solid to the gaseous state or vice versa when heating it?

Investigate the change in benzoic acid during heating and subsequent cooling. Write down your observations and solve the tasks in the protocol.

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Equipment

Position	Material	Item No.	Quantity
1	Protecting glasses, clear glass	39316-00	1
2	Rubber gloves, size M (8), one pair	39323-00	1
3	Support base, variable	02001-00	1
4	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
5	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
6	Ring with boss head, i. d. = 10 cm	37701-01	1
7	Spatula, powder, steel, l=150mm	47560-00	1
8	Benzoic acid 100 g	30251-10	1
9	Watch glass, dia.60 mm	34570-00	1
10	Butane burner with cartridge, 220 g	32180-00	1
11	Beaker, 150ml, low-form	46060-00	1

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Set-up (1/4)

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Assemble the tripod from the tripod base and rod as shown in Fig. 1 and Fig. 2.

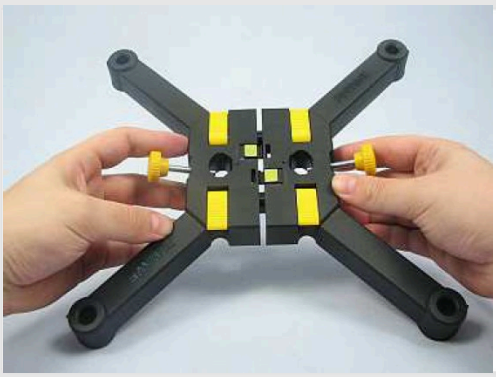

Fig. 1

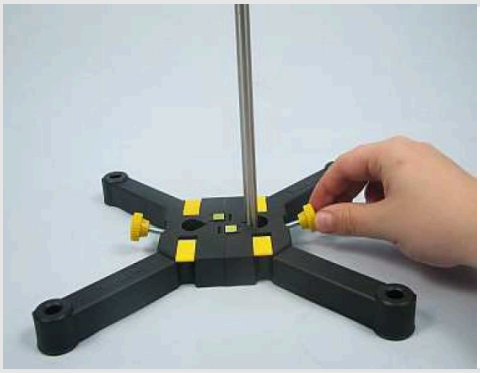

Fig. 2

Set-up (2/4)

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Attach the stand ring to the stand rod (Fig. 3) and place the wire netting on the stand ring (Fig. 4).

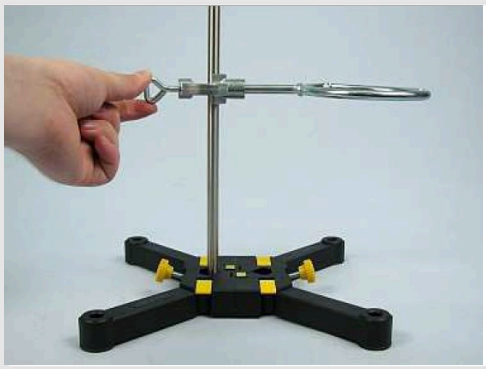

Fig. 3

Fig. 4

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Set-up (3/4)

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Fig. 5

- Use a spatula to absorb the benzoic acid dispensed
- Add benzoic acid to the beaker until the bottom is covered (Fig. 5).

Set-up (4/4)

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Place a plant in the beaker (Fig. 6) and cover the beaker with the watch glass (Fig. 7)

Fig. 6

Fig. 7

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Procedure (1/2)

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Place the beaker on the wire netting (Fig. 8) and pour some water into the watch glass (Fig. 9).

Fig. 8

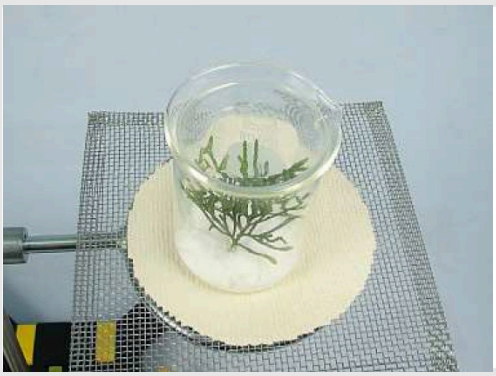

Fig. 9

Procedure (2/2)

Fig. 10

- Heat the beaker carefully with the smallest burner flame (Fig. 10)
- After a white mist has settled on the watch glass, turn off the Bunsen burner and let the beaker cool down
- Take a close look at the benzoic acid during the experiment.

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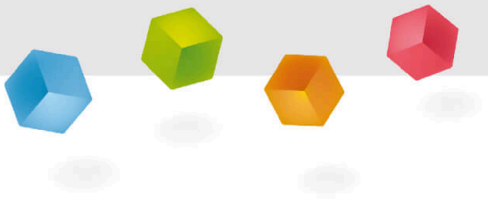

Report

Task 1

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Write down your observations

The solid benzoic acid at the bottom of the beaker [ ] within a short time. During this process the benzoic acid disappears and a [ ] fog is formed, this fog is [ ] benzoic acid. This settles on the colder plant as a frost and it starts to "snow".

Check

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Task 2

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Apply the terms sublimation and resublimation to the observed processes.

- [ ] Due to the increase in temperature, the benzoic acid in the beaker sublimates.
- [ ] After cooling, the benzoic acid changes its aggregate state again, becomes solid and settles on the plant. This process is called sublimation.
- [ ] The white mist in the beaker is benzoic acid in gaseous state. The transition from the solid to the gaseous state is called sublimation.

Check

Slide	Score / Total
Slide 17: Benzoic acid	0/3
Slide 18: Sublimation/ Resublimation	0/2

Total amount 0 / 5

Solutions Repeat

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