

# Chemistry 1B | Lab 2: Compounds of Sulfur

## 化学1B | 实验2：Sulfur的化合物

### Experiment Purpose | 实验目的

This is an **investigative experiment** designed to help you:

- Explore the properties and reactions of sulfur compounds through hands-on observation
- Investigate characteristic chemical reactions through systematic experimentation
- Develop understanding of compound properties and applications
- Practice safe laboratory techniques with various chemical compounds

这是一个**探究性实验**，旨在帮助你：

- 通过亲手观察探索硫化合物的性质和反应
- 通过系统实验研究特征化学反应
- 培养对化合物性质和应用的理解
- 练习使用各种化学化合物的安全实验室技术

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# Safety Learning | 安全学习

> Inquiry-Based Learning Prompt | 探究式学习提示 > Before starting this experiment, think about the following questions and research the answers. > 在开始实验前, 请思考以下问题并查阅资料。

## Pre-lab Safety Questions | 实验前安全问题

- **Question 1**

– What are the hazards of sulfur dioxide gas? – What are the hazards of sulfur dioxide gas?

- **Question 2**

– How should you safely burn sulfur? What precautions are needed? – How should you safely burn sulfur? What precautions are needed?

- **Question 3**

– What should you do if you inhale sulfur dioxide? – What should you do if you inhale sulfur dioxide?

- **Question 4**

– Why must sulfur combustion be done in a fume hood? – Why must sulfur combustion be done in a fume hood?

- **Question 5**

– How should sulfur-containing waste be disposed of? – How should sulfur-containing waste be disposed of?

# Safety Guidelines | 安全指南

## > ! CRITICAL SAFETY WARNINGS | 重要安全警告

- Personal Protection | 个人防护

– Always wear safety goggles and lab coat – 始终佩戴护目镜和实验服 – Use gloves when handling chemicals – 处理化学品时使用手套

- Chemical Handling | 化学品处理

– Read all labels carefully before use – 使用前仔细阅读所有标签 – Never taste or directly smell chemicals – 绝不可品尝或直接闻化学品

- Emergency Procedures | 应急程序

– Know the location of safety equipment – 了解安全设备的位置 – Report all accidents immediately – 立即报告所有事故

- Waste Disposal | 废物处理

– Dispose of chemicals in designated containers – 将化学品放入指定容器 – Never pour chemicals down the drain without permission – 未经许可绝不可将化学品倒入下水道

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# Experimental Preparation | 实验准备

## Materials and Equipment | 材料与仪器

### Chemicals | 化学药品:

- Sulfur sample or compounds | Sulfur样品或化合物
- Various reagents for testing | 各种测试试剂
- Indicator solutions | 指示剂溶液

- Distilled water | 蒸馏水

## Equipment | 实验仪器:

- Test tubes and test tube holder | 试管和试管夹
- Beakers (various sizes) | 烧杯 (各种尺寸)
- Graduated cylinders | 量筒
- Dropper pipettes | 滴管
- Stirring rods | 搅拌棒
- Alcohol lamp | 酒精灯
- Watch glass | 表玻璃
- pH paper | pH试纸

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# Experimental Procedure | 实验操作

> Inquiry-Based Learning | 探究式学习 > During the experiment, focus on careful observation of phenomena and think about the questions provided. > 在实验过程中, 请仔细观察现象并思考提供的问题。

## Part 1: Initial Observations | 初步观察

### Procedure | 操作步骤

- Observe the sample | 观察样品

– Examine the physical appearance – 检查物理外观 – Note color, state, and texture – 注意颜色、状态和质地

### Observations | 观察与记录

**Please carefully observe and record:**

- Describe the appearance:

描述外观: Your observation | 你的观察: \_\_\_\_\_

**Inquiry Questions | 探究问题**

- What can you infer about the substance from its appearance?

从外观你能推断出什么?

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**Part 2: Chemical Reactions | 化学反应****Procedure | 操作步骤**

- Perform test reactions | 进行测试反应

– Add appropriate reagents – 加入适当的试剂 – Observe and record changes – 观察并记录变化

**Observations | 观察与记录****Please carefully observe and record:**

- What changes occur?

发生了什么变化? Your observation | 你的观察: \_\_\_\_\_

**Inquiry Questions | 探究问题**

- What type of reaction is occurring?

发生了什么类型的反应?

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[Additional experimental parts would be added based on specific element]

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# Experimental Principles | 实验原理

Now that you have completed the experimental procedures and made observations, let's understand the underlying principles.

现在你已经完成了实验操作并进行了观察，让我们来理解其背后的原理。

## 1. Hydrogen Sulfide ( $\text{H}_2\text{S}$ ) | 硫化氢

### Properties | 性质:

- Colorless gas (无色气体)
- Rotten egg odor (臭鸡蛋气味)
- Highly toxic (剧毒)
- Soluble (可溶) in water (易溶于水)

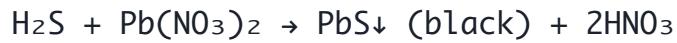
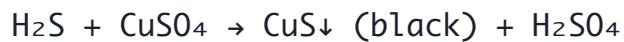
### Acidic Properties | 酸性:



### Reducing Properties | 还原性:



### Precipitation Reactions | 沉淀反应:



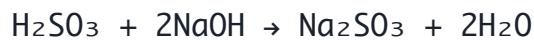
## 2. Sulfurous Acid ( $\text{H}_2\text{SO}_3$ ) | 亚硫酸

### Formation | 生成:

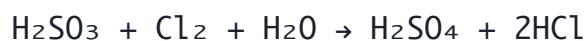


- Unstable, exists only in solution (不稳定, 仅存在于溶液中)

### Acidic Properties | 酸性:



### Reducing Properties | 还原性:



## 3. Sulfuric Acid ( $\text{H}_2\text{SO}_4$ ) | 硫酸

### Properties | 性质:

- Colorless, oily liquid (无色油状液体)
- Highly corrosive (强腐蚀性)
- Strong acid (强酸)
- Hygroscopic (吸水性)

## Dilute H<sub>2</sub>SO<sub>4</sub> Reactions | 稀硫酸反应: *With Metals / 与金属:*



## *With Bases / 与碱:*



## *With Metal Oxides / 与金属氧化物:*

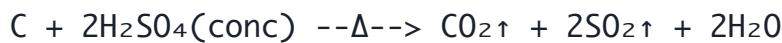
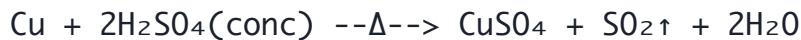


## Concentrated H<sub>2</sub>SO<sub>4</sub> Special Properties | 浓硫酸特殊性质: 1. *Dehydration / 脱水性:*



- Chars organic materials (使有机物炭化)

## 2. *Oxidizing Property / 氧化性:*



## 3. *Hygroscopic / 吸水性:*

- Absorbs moisture from air (从空气中吸收水分)
- Used as desiccant (用作干燥剂)

## 4. Sulfites and Sulfates | 亚硫酸盐和硫酸盐

Sodium Sulfite ( $\text{Na}_2\text{SO}_3$ ) | 亚硫酸钠:



- Reducing agent (还原剂)
- Food preservative (食品防腐剂)

Sodium Sulfate ( $\text{Na}_2\text{SO}_4$ ) | 硫酸钠:



- Glauber's salt:  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  (芒硝)
- Used in glass and detergent production (用于玻璃和洗涤剂生产)

Barium Sulfate ( $\text{BaSO}_4$ ) | 硫酸钡:



- White precipitate (白色沉淀)
- Insoluble (不溶) in acids (不溶于酸)
- Used to test for  $\text{SO}_4^{2-}$  ions (用于检验 $\text{SO}_4^{2-}$ 离子)
- Medical imaging (医学成像)

## 5. Industrial Production of $\text{H}_2\text{SO}_4$ | 硫酸的工业生产

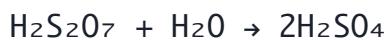
Contact Process | 接触法: Step 1: Burn sulfur / 燃烧硫:



### Step 2: Oxidation / 氧化:



### Step 3: Absorption / 吸收:



## 6. Applications | 应用

### $H_2SO_4$ :

- Fertilizer production (肥料生产)
- Petroleum refining (石油精炼)
- Metal processing (金属加工)
- Battery acid (电池酸)
- Chemical synthesis (化学合成)

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## Knowledge Summary | 知识点梳理

### I. Key Properties | 关键性质

## Physical Properties | 物理性质:

- [Properties will be summarized based on observations]
- [根据观察总结性质]

## Chemical Properties | 化学性质:

- [Reactions will be summarized based on experiments]
- [根据实验总结反应]

## II. Important Reactions | 重要反应

[Key chemical equations from the experiment] [实验中的关键化学方程式]

## III. Applications | 应用

[Practical applications of the element/compounds] [元素/化合物的实际应用]

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## Post-lab Questions | 实验后思考

Based on your observations and understanding of the principles, answer these questions:

- **Observation Analysis | 观察分析**

– What were the most significant observations in this experiment? – 本实验中最重要的观察是什么?

- **Reaction Mechanisms | 反应机理**

– Explain the mechanisms behind the key reactions observed. – 解释观察到的关键反应的机理。

- Safety Considerations | 安全考虑

– What safety precautions were most important in this experiment and why? – 本实验中哪些安全预防措施最重要？为什么？

- Practical Applications | 实际应用

– How are the properties observed in this experiment used in real-world applications? – 本实验中观察到的性质如何在实际应用中使用？

- Comparative Analysis | 比较分析

– How do the properties of this compound compare to related substances? – 这个化合物的性质与相关物质相比如何？

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## Experiment Completed | 实验完成

Remember to clean all equipment and properly dispose of all chemical waste according to safety guidelines.

记得清洁所有设备并按照安全指南正确处理所有化学废物。