

11.5 铜、银

**main characteristics of the ds block elements:**

- ① 具强的极化力。
- ② 易形成配合物。

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11.5 铜、银

- ▶ 11.5.1 单质
- ▶ 11.5.2 重要化合物

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11.5.1 单质


**1. physical properties of copper and silver:**

- ① 熔、沸点;
- ② 导电性、导热性;
- ③ 延展性;

**2. chemical property:**

$$2\text{Cu} + \text{O}_2 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{Cu}_2(\text{OH})_2\text{CO}_3 \text{ (绿)}$$


若有难解离物的生成,会使Cu、Ag及Au单质还原性增强。



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11.5.1 单质

$$4\text{Ag} + 2\text{H}_2\text{S} + \text{O}_2 \rightarrow 2\text{Ag}_2\text{S} \text{ (黑)} + 2\text{H}_2\text{O}$$

$$2\text{Ag} + 2\text{H}^+ + 4\text{I}^- \rightarrow 2[\text{AgI}_2]^- + \text{H}_2 \uparrow$$


$$4\text{Cu} + \text{O}_2 + 2\text{H}_2\text{O} + 8\text{NH}_3 \rightarrow 4[\text{Cu}(\text{NH}_3)_2]^+ \text{ (无色)} + \text{OH}^-$$

$$\text{O}_2 \downarrow$$

$$[\text{Cu}(\text{NH}_3)_4]^{2+} \text{ (蓝色)}$$

$$2\text{Cu} + 2\text{HCl} + 4\text{CS}(\text{NH}_2)_2 \text{ (硫脲)} \rightarrow 2[\text{Cu}(\text{CS}(\text{NH}_2)_2)_2]^+ + \text{H}_2 \uparrow + 2\text{Cl}^-$$

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11.5.2 重要化合物

**1. Properties of main compounds:**

**(1) 溶解性:**

**MO与MOH:**

CuO略显两性; Cu(OH)<sub>2</sub>两性偏碱性:

$$\text{Cu}(\text{OH})_2 + 2\text{OH}^- \rightarrow [\text{Cu}(\text{OH})_4]^{2-} \text{ (亮蓝色)}$$


**盐:**

$$\text{CuCl} > \text{CuBr} > \text{CuI} > \text{CuSCN} > \text{CuCN} > \text{Cu}_2\text{S}$$

$$\text{AgCl} > \text{AgBr} > \text{AgI}$$

**(2) 热稳定性:**

氧化物分解温度: Cu<sub>2</sub>O > CuO.



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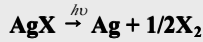
### 11.5.2重要化合物

银的化合物更不稳定:  $\text{Cu}_2\text{O} > \text{Ag}_2\text{O}$



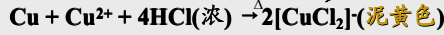
#### (3)光敏性:

许多  $\text{Ag(I)}$  化合物对光敏感:



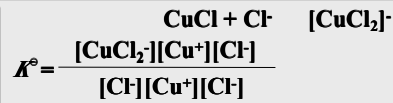
#### (4)配位性:

##### ①Cu(I):



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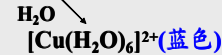
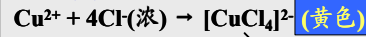
### 11.5.2重要化合物



$$= \beta_2 \times K_{\text{sp}}^{\ominus} = 6.91 \times 10^4 \times 1.7 \times 10^{-7} = 1.1 \times 10^{-2}$$

另外,  $[\text{Cu}(\text{NH}_3)_2]^+$  易被氧化.

##### ②Cu(II):



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### 11.5.2重要化合物

有关电对的电极电势:

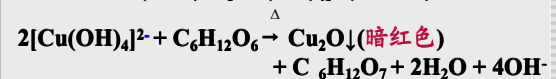
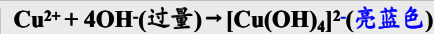


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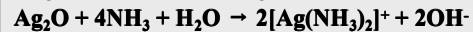
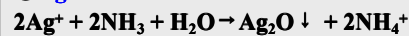


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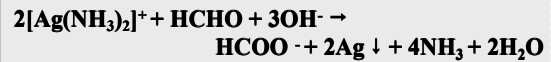
### 11.5.2重要化合物



##### ③Ag<sup>+</sup>:



银镜反应:



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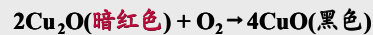
### 11.5.2重要化合物

#### (5)其它较典型的性质:

①  $\text{CuCl}$  的盐酸溶液吸收  $\text{CO}$  形成  $\text{Cu}(\text{CO})\text{Cl} \cdot \text{H}_2\text{O}$ ; 测定  $\text{CO}$  含量.

② 无水  $\text{CuSO}_4$  具强吸水性; 检验或除去有机液体中微量水.

③ 当有氧存在时,适当加热  $\text{Cu}_2\text{O}$  能生成  $\text{CuO}$ ; 除去氮气中的微量氧:



④  $\text{Ag}^+$  与  $\text{S}_2\text{O}_3^{2-}$  反应较为典型. 鉴定.



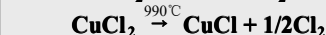
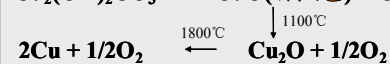
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### 11.5.2重要化合物

#### 2. stability and transform each other of Cu(I) and Cu(II):

$\text{Cu}^+$  价电子层构型:  $3d^{10}$ .

高温、固态时稳定性:  $\text{Cu(I)} > \text{Cu(II)}$

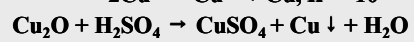
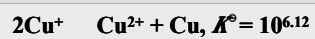


水溶液中稳定性:  $\text{Cu(I)} < \text{Cu(II)}$

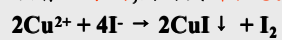


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### 11.5.2重要化合物



若要使溶液中**Cu(II)**转变为**Cu(I)**并稳定存在，  
必须有**还原剂**，同时要**降低Cu(I)浓度**。



电对的变化，**电极电势**也发生改变。

