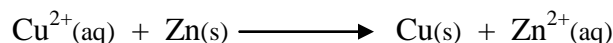


## Laboratory Exercise: The Synthesis of Copper Metal

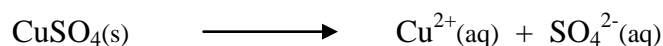
In this exercise we will convert an Ion of Copper ( $\text{Cu}^{2+}$ ) into atoms of Copper ( $\text{Cu}$ ) by transferring two electrons from a Zinc atom ( $\text{Zn}$ ) to the ion.



Copper metal is one of nine Elements known since antiquity; carbon, sulfur, iron, tin, lead, mercury, silver and gold being the others. This is due to the fact that the smelting of Copper containing ores to isolate the pure metal was one of the first smelting processes to be discovered. Early Romans referred to the metal as *aes Cyprium*; *aes* being a generic term for alloys of Copper and *Cyprium* because most of the Copper ores were mined in Cyprus. This was later shortened to *cuprum* and then Anglicized into *Copper*. Copper is a reddish-brown metal that is an excellent conductor of heat and electricity, being second only to Silver. It is alloyed as Bronze (with Tin) and Brass (with Zinc). It is a softer metal than Iron but harder than Zinc.

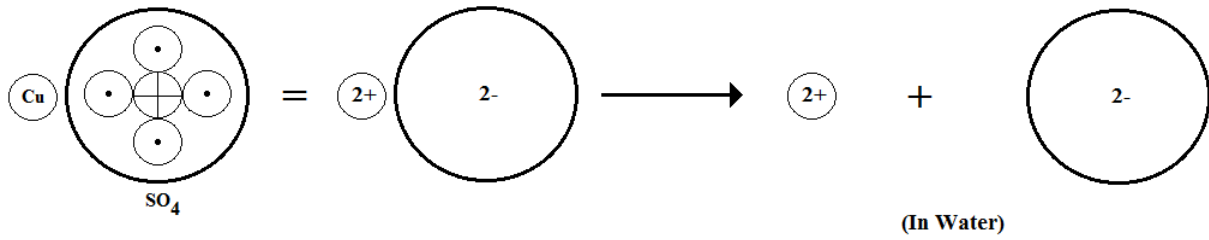


Our source of Copper ions will be a Copper salt, Cupric Sulfate ( $\text{CuSO}_4$ ), which when dissolved in Water dissociates into a Copper ion and a Sulfate ion (more on this later). When in an aqueous environment, the Copper ion has a beautiful dark blue color.



Why exactly Zinc atoms are willing to give up two electrons to the Copper ion is a question for another day. But, you should note that the  $\text{Cu}^{2+}$  and  $\text{SO}_4^{2-}$  ions exist in their ionic form within

the compound. Water simply serves as an insulating fluid to separate the ions. Further, the Sulfate Ion  $\text{SO}_4^{2-}$  is a polyatomic ion; a collection of atoms, bound together, which has collectively picked-up two electrons. It has obtained these two electrons from the Copper atom. The two electrons have not been transferred to any particular atom within this "collection," instead the electrons are part of the bonding holding the polyatomic ion bound together. (Again, more on this later.)



## Procedure

1. Weigh out 2.0g of Cupric Sulfate ( $\text{CuSO}_4$ ) Pentahydrate and add it to a 125 mL Erlenmeyer flask. Add 50 mL of Water to the flask.
2. Heat with occasional stirring on a hot plate to hasten the dissolution. Once the salt has dissolved, remove the solution from the hot plate and allow it to cool briefly.
3. Add 6 mL of 3M Sulfuric Acid ( $\text{H}_2\text{SO}_4$ ). Then add two crushed pieces of mossy Zinc. This must be done in this order. Some gas will be evolved at this point.
4. Place the flask back on the hot plate and heat with occasional stirring until the solution is nearly colorless.
5. Carefully decant the liquid from the solids.
6. Add 25 mL of Water and swirl. Decant the liquid again. Repeat this washing procedure.
7. Remove any unreacted Zinc with a spatula. Wash any adhering bits of Copper back into the flask with a stream of Water from a wash bottle.
8. Add just enough Water to the flask so as to be able to wash the Copper into a filter funnel. Do this, adding additional Water to the flask to wash the remaining Copper into the funnel as well.
9. Allow the Copper to air dry on the filter paper for a few minutes.
10. Weigh the Copper.
11. Determine the percentage Copper recovered from the salt.

## Data Sheet

*Make appropriate observations and Record needed data here.*

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

## Data Analysis

1. Determine the Percentage Copper in the salt Cupric Sulfate Pentahydrate.

## Post Lab Questions

1. What is the Limiting Reagent in this reaction? Explain.
2. What gas is being produced in step 3 of the procedure? How do you know this?
3. What visual clue lets us know all the Copper ion has been converted into Copper metal?