Bring a penny to class for this lab!

The Preparation of "Gold"

The history of chemistry includes many dubious periods where techniques for the transmutation of base metals into precious metals were promised to kings and queens. These deals tended to end badly (and bloody) for the "alchemists" who made the promises. They were promising chemical changes, but providing physical changes. During a physical change, some properties of a material change but the composition of the material does not change. We are going to see how some of these fifteenth century Royals were hoodwinked by replicating two of the alchemists "tricks".

In this reaction, sodium zincate (Na_2ZnO_2) is formed by heating elemental zinc with sodium hydroxide solution.

$$Zn(s) + 2NaOH(aq) \rightarrow Na_2ZnO_2(aq) + H_2(g)$$

When a copper penny is added to this solution, the zincate ions (ZnO_2^{-2}) migrate to the copper where they are decomposed and reduced to metallic zinc - coating the penny. When the zinc-coated penny is heated, the penny becomes gold in color. The gold color is due to the zinc and copper combining to form the metallic *mixture* "brass". A mixture is a physical blend of two or more compounds.

Brass is a copper-zinc alloy. Most textbooks describe an alloy as a mixture of two or more metals (or a metal and a non-metal fused together) dissolved into each other when molten. There are metallic bonds between the components of most alloys. The percentages of copper and zinc in brass vary depending on the type of brass. Some brasses contain small percentages of other elements like aluminum, tin, and silicon.

Safety Precaution:

Sodium hydroxide solution is extremely corrosive and can cause skin burns and severe, irreversible eye damage. Care should be taken when heating it so that it doesn't splatter. Eye protection is a requirement for this lab. Put 'em on, and leave 'em on. Recycle the sodium hydroxide/zinc bath in the designated container.

Procedure:

1. Mix together 3.0 grams of sodium chloride and 15 mL of vinegar in a clean 100 mL beaker.
2. To clean the copper pennies, place them in the sodium chloride/vinegar solution until they are shiny.
3. Remove the pennies with forceps and rinse them thoroughly with water. Dry with paper towel. Do not handle the clean pennies with your hands. The oils from your skin can interfere with the reaction.
4. Mix together 0.5 grams of granular zinc and 24 mL of 3M sodium hydroxide solution in a clean pyrex dish. Chemical splash goggles must be worn.
5. Using a hot plate, carefully heat the mixture until it is steaming. Do not allow the solution to boil or splatter.
6. Using tongs, immerse the penny in the mixture until it's completely coated with "silver".
7. Have your teacher use tongs to remove the penny. CAUTION: the penny will be very hot. Carefully dip the penny into a beaker of distilled water. Shine with towel. The penny should now appear silver.
8. Using tongs, heat the penny directly on the hot plate until the penny turns gold. Immediately dip the penny into a fresh beaker of distilled water to cool. The penny will be extremely hot and should be handled with tongs until it has cooled for several minutes.

Chemistry Lab
Preparation of "Gold"

Name _____
Date _____ Per ____

Answer the following questions as completely as you can. Use your textbook to help you.

1. Identify the two metals that compose your brass alloy.

2. Give a general definition of an alloy.

3. Is brass an interstitial or substitutional alloy? How can this be determined using the periodic table? (hint: read p. 203 in your textbook)

4. Why was heat needed to cause the zinc coating to diffuse into the copper?

5. When the penny turned silver, was this a physical change or a chemical change? Explain why.

6. After heating, the silver penny was changed into a gold penny. Was this change physical or chemical? Explain how you know.

7. What did you learn from this? If you were a member of some royal court 500 years ago, how could you prove the penny was not transmuted to silver and gold?

Have you followed all your teacher's special directions? Is your lab station clean? Check before leaving the lab.