

Gold Foil Application

Deborah E. Love Jemmott

© 2001 Rev 2003/2006

Tools and Supplies

Cotton gardening gloves - a soft, clean pair with no plastic or rubber parts

Leather gloves - thin leather works best

Metal burnisher (highly polished with the point rounded/any size) - the Japanese burnisher works very well. Ball burnishers work well.

Agate Burnisher

Fine pointed tweezers to place gold

Large tweezers to hold piece while burnishing

Self-locking tweezers to hold difficult pieces to hot plate coil - several pair

Small cup of water

Small scissors

Scalpel or X-acto Knife

Hole Punches - round and shapes

Fired art clay silver pieces (burnished (tumbled) or frosty white is fine)

Hot plate (NOT warming tray) or torch

Wood stove chimney thermometer

Gold foil

Organic Glue: Rice Glue / Mucilage Glue / Book Binder Glue / Gum Tragacanth

The Background

Gold can be applied to the surface of another metal using several techniques. Three types are: mechanical bonding, diffusion/fusion bonding, and chemical bonding. The technique we will use is partially diffusion bonding (using heat) and partially mechanical (burnishing). It is similar to the Korean Keum-boo (also spelled Kum-boo or Kum-bu) technique.

Gold can be diffusion bonded to a variety of metals including iron, steel, copper, palladium, white gold, platinum and sterling. In researching this process, I found much conflicting information and much misinformation. While I do not really understand what is happening on a molecular level, I have been able to achieve excellent results. In practice, I found this technique quite easy to do as long as these instructions are followed.

The Gold Foil

This will only work with 24K gold. There is something that happens on a molecular level that makes it possible for 24K gold to adhere to almost any metal when the appropriate amount of heat and pressure are applied.

The first issue is finding gold of appropriate thickness. If the gold is too thick, it will not allow the oxygen molecules to pass through it and will not adhere. If the gold is too thin, once adhered, it will have a slight green tint from the silver or other metal showing through the gold. Gold leaf is much too thin for this application. The material commercially available, although it is on the thin side (.0005" in thickness), is the gold foil used for enameling or the gold foil from Art Clay. This is about the thinnest the gold can be to give good color and adhere well.

Another alternative is to make your own gold foil. This material will be much thicker - the thinnest I was able to achieve ranged from .0015" to .002. It is still thin enough to adhere well and the thicker material is a bit easier to handle.

To make a sheet of gold foil, purchase the thinnest sheet of 24K gold available. (I found 32ga - .00795"). You will need a rolling mill in excellent shape (rollers flat, smooth and properly adjusted). Work with a narrow piece of metal (no wider than 1") in order to achieve thinner foil. Roll it through the rolling mill for 2 or 3 passes with medium to heavy pressure on the crank. Anneal the metal and roll it again. 24K gold anneals at 575°F. Annealing can be achieved with a torch, in a kiln, or by laying the gold on the hotplate on full heat for about 2 minutes. Continue the rolling and annealing process until the rollers cannot be tightened any more. You will need to make several passes at the tightest the mill will go to achieve .0015"- .002". If you have access to a micrometer or calipers capable of measuring these tiny dimensions it will help you know when your metal is to the correct thickness.

The Process

All soldering and finishing steps should be completed before beginning the gold application. Minimal heating (low temperature solders or extra-easy solder with great care) can be successful. Gold and silver will form a eutectic bond just above medium solder temperatures, so the piece should not be taken to that level. Cold working techniques can be completed after the gold is applied. The gold and the metal the gold will be applied to should both be clean.

1. The gold can be cut or torn into the desired shape. If a ragged edge is desired, tear the gold and run it through the mill several more times without annealing. Anneal the gold before using. If a cut design is desired, small scissors, a scalpel, an x-acto knife can be used. A paper punch can also be used, but the gold is so thin that it will tear rather than making a clean cut unless it is placed between sheets of paper.

2. If the placement of the gold is critical, it can be glued in place before the bonding process. If the gold can be hand held in location, there is no need to glue it. Place a small amount of diluted organic glue on the back of the gold or dip the gold into a thin mixture of glue and water. Position the gold pieces on the silver and allow it to dry.
3. The hotplate must be capable of reaching 1000°F - 1100°F in order to heat the piece sufficiently to adhere the gold. A wood stove thermometer is a relatively inexpensive way to make sure that the hot plate is at least 900°F. Turn the hotplate on high to high (this can also be done with even and consistent torch heat) and wait for the piece to heat. The piece should be between 650°F and 850°F.
4. Wear gloves for this next part (I use a leather glove on my left hand and a cotton glove on my right hand). While holding the silver piece firmly with tweezers, roll the burnisher over the gold. The gold will not bond with the piece until the combination of pressure and temperature is sufficient. If the burnisher gets hot enough before the piece gets hot enough, the gold will bond onto the burnisher. Keep a small cup of water nearby to dip the metal burnisher and tweezers into. If you are using an agate burnisher, the gold will not stick to it - and NEVER dip a hot agate burnisher into water. When the silver is hot enough, the gold will diffusion bond to the piece. Small pieces of gold can be bonded fairly easily. Bonding on textured or dimensional surfaces is more difficult. Use a burnisher with a small tip to tack the gold in place gently but firmly. Then work in small sections until the gold is fully adhered. Be sure to burnish the edges well so the bond will be secure.
5. For large pieces of gold, a more complex procedure may be appropriate. Use a polished burnisher with a larger working surface and tack the gold fixing it in place. Slowly and evenly, burnish larger areas until the entire piece of gold is adhered. To make as smooth a surface as possible, burnish first one direction beginning in the middle and working to the outer edges of the gold piece. Then burnish the same piece in the other direction. Continue pressure by rolling or rubbing with a burnisher increasing the pressure as the bonding occurs. Be sure to burnish the edges well so the bond will be secure.
6. For large pieces, the hotplate may not have sufficient heat to achieve the temperature needed for gold diffusion bonding. A torch may be used in conjunction with the hot plate.