

beginner/intermediate

metal

SOLDER-FREE HOLLOW BEAD

# Fahrenheit

*Fuse silver to silver  
and fuse gold to silver  
to make a seamless sphere.*

by Patricia Tschetter



# 650° the temperature at which keum-boo fuses

If you heat gold to about 650°F (343°C), its molecules not only become excited, they actually show changes in their electron rings. In an article published on the Orchid Forum ([www.ganoksin.com](http://www.ganoksin.com)), Charles Lewton-Brain suggests that this change might explain the fascinating ease with which gold bonds to other metals at that temperature. This phenomenon is exploited beautifully in keum-boo (also spelled kum-boo and kum-bu), a technique for fusing pure gold to silver using only low heat and pressure (no solder) in order to make a surface decoration. This process originated long ago in Korea, where the symbol "keum" means "gold" and "boo" means "attached."

With keum-boo's rising popularity, it's easy to find ultra-thin 24k or 22k gold foil. However, I prefer to make my own. The thin, commercially available foil stuck to my silver almost instantly. My slightly thicker handmade version, however, doesn't stick immediately. So, I have enough time to adjust the placement of the gold and position it exactly where I want it in the design.

**Cut the fine-silver disks.** Using a circle template, trace two identical circles onto 22-gauge (0.6 mm) fine-silver sheet. (See "What About Sterling Silver?" page 67, to find out how to substitute sterling for fine silver.) My circles are  $\frac{3}{8}$  in. (22 mm) in diameter. Cut the circles out using a jeweler's saw and 4/0 blades (see Basics, page 78). Alternatively, you can use a disk cutter to cut two circles out of the sheet [1].

**NOTE:** When you're deciding how big to make your disks, note that the finished beads will be smaller in diameter than your disks as a result of the dapping process.

Also, the sheet's gauge will make a difference in the bead's size. For example, if you were to cut a disk of thin-gauge sheet to make a dome, and you wanted to make the same size dome in a thicker gauge, you'd have to cut a larger disk.

**Form the disks into domes.** Place one fine-silver disk into a depression of your dapping block that has a slightly larger diameter than the disk. Hold the corresponding dapping punch on top of the disk, and tap the punch with a hammer or rawhide mallet until the disk becomes a dome.

To make sure that the edges of the metal don't crack, anneal the dome as necessary. See Basics, page 78, for instructions on how to anneal.

To prevent yourself from sanding too much material away when you're fitting the domes to each other, make sure the height of each dome is a little more than half of the disk's diameter.

After the initial dapping, it's likely that your dome will still be too shallow. If you were to join the two domes at this point,

they'd form a slightly distorted sphere. If your dome isn't high enough, shift it to a smaller depression in the dapping block and use a smaller punch. Turn the dome on its side so that its edges are perpendicular to the dapping block. Use the smaller punch along the inside of the dome to continue shaping it [2]. Repeat to dome the other disk.

**TIP:** To make it easier to make taller, more rounded domes, try using a hemispherical dap set.

**Refine and drill the domes.** Check that the domes are the same size and that the edges align without gaps between them. Sand the edges of each dome in a figure 8 motion on sandpaper taped to a sturdy, flat surface. This method ensures that you'll sand the surface evenly, which is important because the edges need to meet flush or they won't fuse correctly.

After you've sanded, press the two domes together to make sure that they form a sphere. If not, reshape as necessary.

When your sphere is a good shape, place a dome concave-side up and find its center.

**TIP:** To find the center of a dome, drop a small amount of water into it: the water will roll to the dome's center point. Mark this place with an awl or scribe.

Or, place the dome edge-down on scrap paper and trace it. Remove the dome. Position the circle template

over the tracing, and mark the circle's perpendicular centerlines. Remove the template and extend the lines beyond the circle. Place the dome over the tracing again. Use a permanent marker to make a small tick mark on the outside of the dome at the centerlines. Flip the dome over. Using the outside marks as a reference, draw the centerlines through the inside of the dome.

Place the dome on a steel bench block and use a center punch to make a small dimple at the center point. Then place the dome on your bench pin and use a 1.0 mm drill bit in a flex shaft to drill a hole at that point. Repeat with the other dome [3].

Use a saw or round needle file to enlarge the holes to about  $\frac{1}{8}$  in. (3 mm) in diameter. (I usually saw, then refine the holes using needle files). The holes aren't just a function of the bead. They also provide a convenient gripping point for the locking tweezers, and they vent the hollow form during fusing. Each hole needs to be large enough to allow you to insert plumber's epoxy putty later, which will strengthen the finished bead.

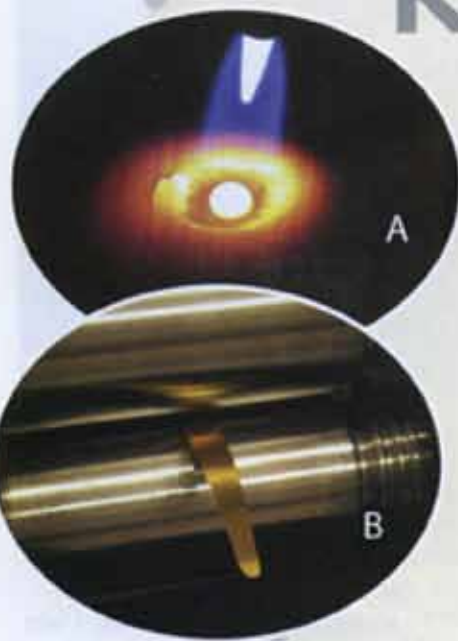
#### Customize your soldering tweezers.

Choose an old or inexpensive set of locking tweezers. If the tips of your pair aren't already annealed through age and use, heat them with a torch until they turn a dull cherry red. Allow them to cool, and then quench them in water. Using a set of utility pliers, bend the tips of the tweezers inward at a 90° angle, an equal length



make your own

# keum-boo gold sheet



Select a new charcoal block, or sand an old one to remove contaminants from the surface. Use a soldering pick to carve a small depression in the block.

Place 24k gold casting grain or scraps into the depression. (You won't need much; I used less than 2 g of gold for my bead.) Heat the gold with a large flame until the gold melts [A]. Let it cool until the red color disappears (working in a darkened room is best), and then quench it. There's no need to pickle it because it's pure gold.

Insert the small gold ball between the rollers of your rolling mill. Adjust the rollers until they are tight against the ball, and roll it. To create a strip, roll the gold four to six times in one direction, tight-

ening the rollers with each pass, until the gold is work-hardened. To anneal the gold strip, heat your charcoal block with your torch until it turns a dull black-red. Remove the torch and place the strip on the hot block. Allow it to cool, and then quench it.

When the rollers are almost completely tight [B], remove the gold strip, sandwich it between two brass or copper sheets, and roll it again to make it even thinner. Check the gauge of the gold strip with calipers or a metal gauge. Gold **must** be thinner than 32 gauge (0.20 mm) to adhere properly. I prefer mine around 36 gauge (0.13 mm). When the gold strip is the desired gauge, don't anneal it; leave it work-hardened so you can cut the shapes without distorting them.

down both tips. I've customized many pairs of tweezers to accommodate the different-sized spheres that I make [4].

**Fuse the domes to make a bead.** Align the edges of the two domes to form a sphere. Insert the bent tips of your locking tweezers into the hole in each dome. Lock the tweezers in place, or wrap binding wire around the tweezers to secure the domes [Figure].

Make sure the tweezers grip the domes securely enough that the domes don't slip. But don't secure them too tightly, or your

sphere may collapse during fusing. Check that the edges are lined up correctly.

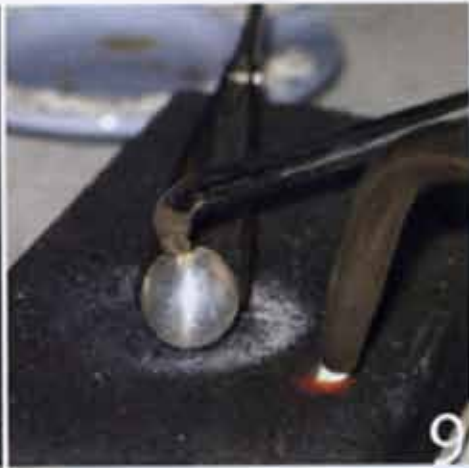
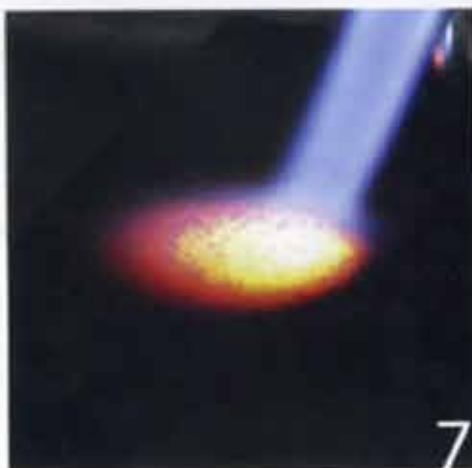
In a darkened room (this will help you see the "flash" that indicates that the silver has fused), heat the entire sphere with a large reducing flame [5]. Keep the torch moving, and heat the piece until it turns a dull red. At that point, watch for a bright mercury-like "flash" of melted silver along the join of the two domes. Move the torch around the seam until you have fused the two domes completely, making a bead. It may take several attempts to fuse the sphere completely.

Allow the bead to cool. Sand the bead, particularly along the bumpy fused seam, with 320-grit sandpaper. Use progressively finer grits of sandpaper until the bead is smooth. If you use sanding disks in a flex shaft, use light pressure and don't allow the disks to rest in one place long or you may create flat spots.

## Assemble your keum-boo materials.

While you can perform keum-boo on a hotplate or in a small kiln, I like to work on my charcoal soldering block. Charcoal blocks work especially well for non-flat





objects, because you can easily create depressions to hold your piece for fusing.

For instructions on rolling 24k gold sheet, see "Make Your Own Keum-boo Gold Sheet," page 65.

Before you begin, cut out designs from your gold sheet or piece of foil. Decorative paper-cutting punches (like those used in scrapbooking) work well for this, or you can draw your own designs on the sheet and use metal shears to cut them out.

Gold can stick to a hot steel burnisher, so I use a burnisher made of Pyrex [6] — it

stays cool and doesn't need to be quenched during use like the steel version. If you do use a steel burnisher, keep a small bowl of water nearby so you can dip the burnisher frequently to keep it cool.

In place of tweezers, I use the tip of a craft knife to pick up the gold shapes. Although the gold shapes get pierced by the blade, they "heal" once you fuse them onto the silver.

**Apply the gold.** Hold the bead in your modified locking tweezers. The tweezers

need to be secure, but not so tight that they deform your bead. You should be able to roll the bead like a wheel along the charcoal block.

Heat a spot on your charcoal block with your torch until the spot turns red. (If your bead is the size of a nickel, the hot spot should be about the size of a dollar coin.) Keep heating this place for about a minute to build up enough heat [7].

Remove the torch and quickly place the bead on the hot spot. Turn off your torch. Use your craft knife or tweezers to transfer

## want the goods on gold?

### Is your gold too thick?

Gold that is too thick is the main reason keum-boo doesn't adhere. If you have rolled yours on the last setting of your mill, sandwich your gold between brass or copper plates and roll it again.

### Is your gold and/or silver clean?

Charcoal residue can prevent the gold from adhering, so be sure to clean your metal before trying to fuse it.

### Do you have bubbles?

If so, use a pin or the tip of a craft knife to poke a hole into the gold over the bubble. Burnish toward the hole, pushing the air out as you heat and adhere the gold. Once the gold is fused, it's unlikely that you'll see the tiny hole.

### Is your gold too stiff and won't stay where you put it?

When you're working on curved surfaces, it's helpful to anneal the gold first. It's easy to melt the thin gold sheet if you use your torch directly on the metal. Instead, heat a charcoal block, and then place the gold onto the heated spot until it's annealed. Quench the gold when the dull red color disappears from the charcoal.

### Does your gold still refuse to stick?

If it becomes too frustrating to adhere the gold, you can use a little saliva on the back of your gold to hold it on the silver bead where you want it. Let it dry and then heat up the charcoal block and bead, being careful not to overheat the gold. Then burnish the gold. The saliva acts as an organic binder to hold the gold in position long enough for you to burnish it in place.

## what about sterling silver?

Due to its molecular properties, fine silver works best for keum-boo. So, if you want to use sterling silver, you have to build up a thin layer of fine silver on its surface for the gold to adhere to. This process is called "depletion gilding."

Use a torch with a soft, bushy flame to heat the sterling silver, then pickle it and gently brush it with a brass brush. Repeat until your sterling no longer turns black when it's heated. This indicates that there is enough fine silver built up on the surface for the gold to stick to. To protect the fine silver, don't use the brass brush on the final heating.

► Tschetter's keum-boo and granulation earrings were featured in the book *500 Earrings*. 1 1/8 x 1 in. (33 x 25.5 mm).

the gold shape to the desired position on the bead. If necessary, use your burnisher to dislodge the gold shape from the craft knife or tweezers, securing the gold shape onto the bead.

Light your torch, and gently wisp a soft, bushy flame over the bead, being careful not to melt the delicate gold [8]. Keep the bead warm with the flame, and gently rub the burnisher in a rolling motion along the gold shape [9].

Only light pressure is needed; either start on one edge of the gold shape and work your way across the surface, or begin in the middle of the gold shape and work toward the edges. Both methods assure few or no bubbles. See "Want the Goods on Gold?," opposite, if you develop a bubble — it's fixable!

This bonding may take a few tries, depending on the temperature of your bead. If the bead is initially too hot, let it cool by backing off your torch. Eventually the temperature will cool to the 500°–700°F (260°–371°C) range that will cause the gold to stick. Repeat this process to fuse all your gold shapes to your bead.

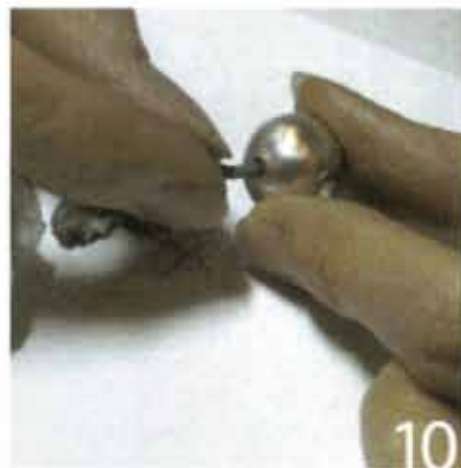
**TIP:** When I keum-boo flat pieces, I use a hotplate and place a steel sheet on its surface. Then I make a scratch in the steel surface. When the hotplate heats, I watch the scratch and note when it turns blue, which indicates the proper temperature for adhering the gold.

Allow the bead to cool slightly and then quench it in water. Check the edges of the fused gold with your fingernail or a pin to make sure they're fully bonded. (Sometimes I reheat the bead and go over all the gold and the edges just to ensure that all the gold is attached, because it's difficult to adhere gold once you've applied liver of sulfur to the piece.)

**Fill the bead with epoxy.** To strengthen the walls and add weight to my hollow beads, I fill them with plumber's epoxy (or steel epoxy) putty. It's a two-part compound that is moldable before it hardens permanently. The working time



▲ Keum-boo works at any size. The beads on these earrings are only 1/8 in. (9.5 mm) in diameter.



of your epoxy will dictate how much you will need to prepare at once. I use a 5-minute epoxy, so I can only use a little at a time before it hardens.

Mix small, equal parts of each compound according to the manufacturer's instructions. Form the mixed putty into a snake, and insert it into the bead bit by bit [10]. Use an awl to push the putty into the bead, packing it tightly against the interior [11]. Remember to keep the hole clear so you can string the bead later. You may find it easier to fill your bead in a few sessions, allowing the epoxy to dry at intervals. Wipe off the wet epoxy as you go; epoxy is much easier to remove before it cures. Remove any dried epoxy from the surface

of the bead by chipping it off with a fingernail. If any epoxy remains, it will prevent the patina from working.

**Finish the bead.** To patinate the bead, use a hair dryer to heat the bead before plunging it into warm liver of sulfur. Use a piece of wire or a jig to hold the bead, because getting fingerprints and oil on the bead will make the patina uneven.

Once the bead is the desired color, place it into a baking-soda-and-water solution to neutralize the liver of sulfur. Rinse the bead well, and buff it with a soft brass brush and soapy water. Allow the bead to dry thoroughly before you apply a protective coating of wax or lacquer. ❧



▼ Tschetter makes striking necklaces by showcasing a large keum-boo bead, like one of these, on a short neck wire without any other adornment. The silver bead is 1 1/8 in. (27 mm) in diameter, and the oxidized bead is 1/2 in. (22 mm).

## materials

- Fine-silver sheet: 22-gauge (0.6 mm), 1 x 2 in. (25.5 x 51 mm)
- Gold (choose from):
  - 24k gold: scrap or casting grain for melting, 2–4 g
  - 22k–24k gold foil
- Plumber's epoxy putty

## tools & supplies

- Circle template (optional)
- Torch station: torch, charcoal block, pickle pot with pickle, flux, copper tongs, binding wire (optional), pick (optional)
- Brass brush: soft
- Jeweler's saw with 4/0 blades; or disk cutter
- Dapping block, punches (hemispherical dapping block preferred)
- Utility hammer or rawhide mallet
- Sandpaper: various grits, including 320 grit
- Permanent marker
- Scribe or awl
- Steel bench block
- Center punch
- Bench pin
- Flex shaft, 1.0 mm drill bit
- Needle files
- Locking tweezers: old or inexpensive
- Utility pliers
- Sanding disks: fine (optional)
- Supplies for rolling your own gold sheet (optional):
  - Rolling mill
  - Calipers or metal gauge
  - 2 scrap sheets copper or brass
- Decorative paper-cutting punches or metal shears
- Pyrex glass or steel burnisher
- Craft knife or tweezers
- Jeweler's files: round, various cuts
- Hair dryer or heat gun
- Scrap wire
- Finishing items (choose from):
  - Liver of sulfur, baking soda
  - Renaissance Wax or Krylon Matte Spray Lacquer

See Suppliers, page 85  
See Safety Basics, page 87