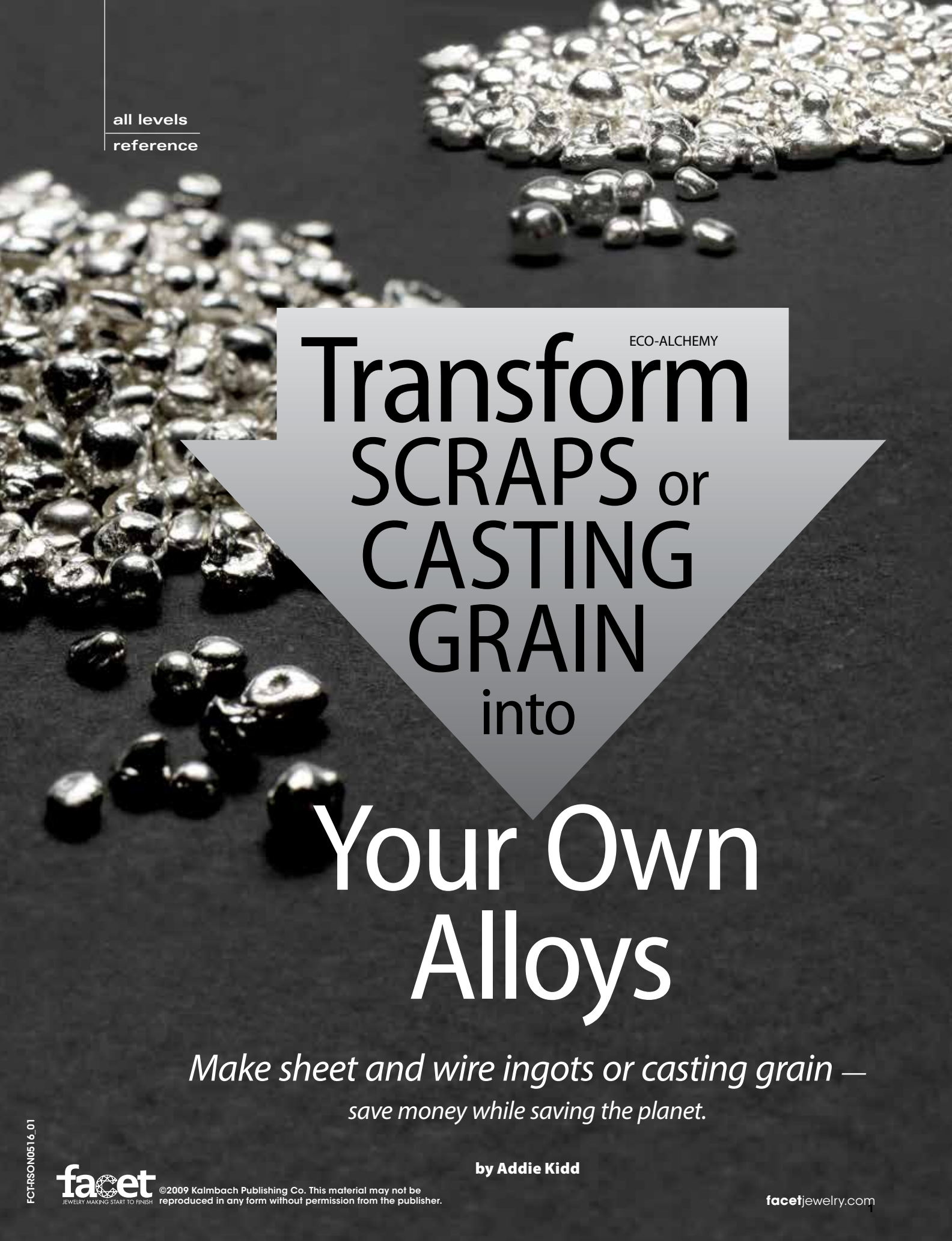
all levels

reference



ECO-ALCHEMY

Transform SCRAPS or CASTING GRAIN into Your Own Alloys

Make sheet and wire ingots or casting grain — save money while saving the planet.

by Addie Kidd

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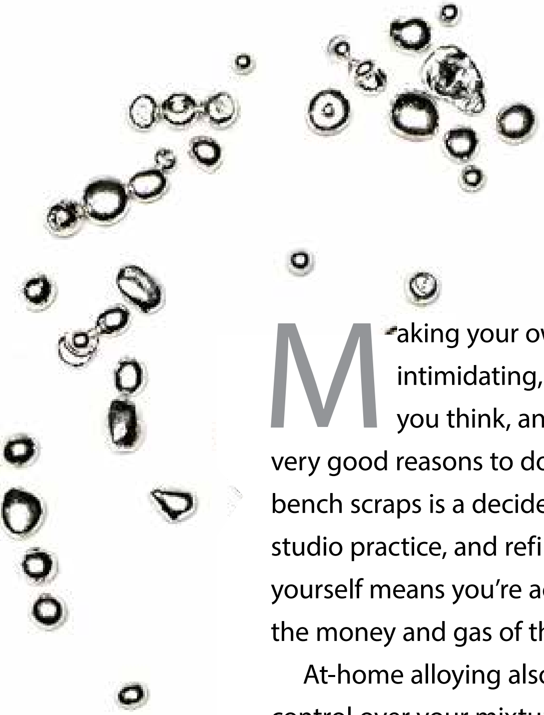
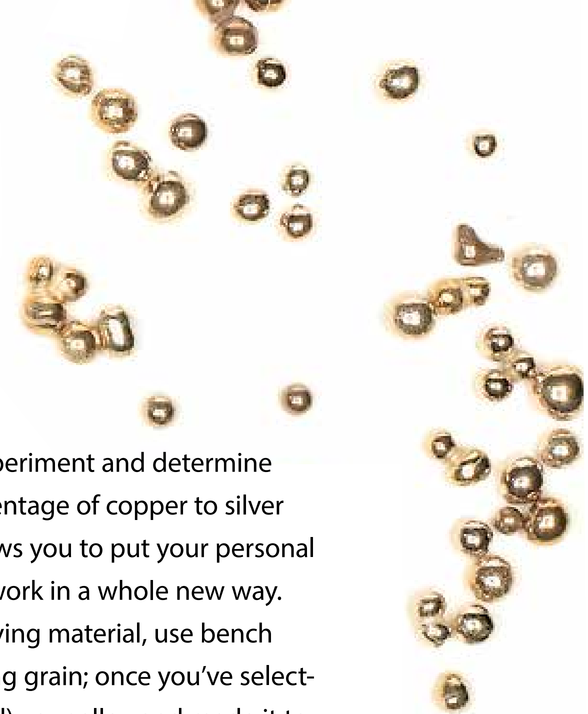




Making your own alloys may sound intimidating, but it's easier than you think, and there are some very good reasons to do it. Reclaiming your bench scraps is a decidedly eco-friendly studio practice, and refining those scraps yourself means you're acting locally, saving the money and gas of the shipping process.

At-home alloying also gives you greater control over your mixtures; having the freedom to experiment and determine just what percentage of copper to silver you prefer allows you to put your personal mark on your work in a whole new way.

For raw alloying material, use bench scraps or casting grain; once you've selected (or designed) your alloy and made it to measure, you can produce ingots of sheet or wire, or casting grain.

Reclaiming scrap

Clean metal. Separate metals (silver, copper, etc.), and place scraps of one type of metal in a crucible. If your crucible is fresh out of the box, see "Brand New Crucible?". Gently heat the metals with your torch — not enough to melt them, just enough to burn off lint, paper, and saw blade or bur lubricant. Allow the scraps to cool.

Remove impurities. Transfer the scraps to a nonmetal container. Use a strong magnet to remove stray tool metals, like broken drills or saw blades, that may be in your scrap.

Make your metal reusable. Place the scraps back in the crucible. Follow the steps in "How to Make an Alloy and Pour an Ingot", to melt the metal and make it into an ingot of sheet or wire or into casting grain; you can now use the metal as-is, or use it to create alloys with other metals.

materials

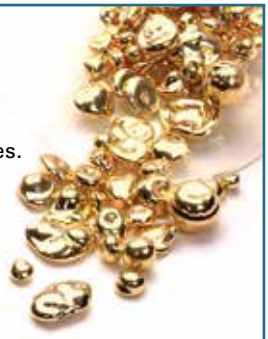
- Scrap metal or casting grain

tools & supplies

- Pouring crucible
- Torch with sufficient heat (choose from):
  - Large-head casting torch
  - Oxygen/propane torch
  - Oxygen/acetylene torch
  - MAPP gas torch
- Kiln (optional)
- Borax or powdered casting flux
- Magnet: strong
- Ingot mold: wire or sheet, carved; or charcoal block
- Liquid lubricant or beeswax
- Scale: jeweler's
- Casting safety glasses: #5 green tint
- Heat-resistant surface (soldering pad, firebrick, or charcoal block)
- Carbon stirring rod
- Copper spoon: small (optional)
- Pickle pot with pickle
- Bench block
- Flat hammer: chasing or planishing
- Rolling mill
- Drawplate (optional)
- Bench vise
- Drawing tongs or vise-grip pliers

! Always make sure that casting grain or scraps are completely dry before you melt them. Even small amounts of trapped moisture can heat into steam and explode, possibly spraying hot metal out of the crucible.

karat VS. carat



- "Carats" indicate the weight of diamonds and gemstones.
- "Karats" indicate the quality of gold.

The gold-quality system consists of 24 parts, or karats. Pure gold is called 24 karat (marked as 24k, 24kt, or 999). That means that 24 out of 24 parts of the metal are pure gold: 99.9% pure gold.

You can always determine the percentage of gold by dividing the gold's karat by 24. Eighteen karat (18k or 750) gold is 18/24: 18 parts gold and 6 parts other metals, or alloy. So 18k gold is 75% pure gold, 14k gold is 58% gold, 12k gold is 50% gold, and 10k gold is 42% gold. Refer to the "Alloy Recipes" chart, for more information on gold karats and alloys.

How to make an alloy and pour an ingot

If you're making casting grains, follow these instructions until the alloy is ready to pour, then see "Goof-Proof Water Casting".

Select an ingot mold. You can use a number of different types of ingot molds depending on what kind of ingot you'd like to make: sheet or wire. Shown here are two versatile double-sided models; one side of each ingot makes sheet **[1a]**, and the other side makes wire **[1b]**.

> **TIP:** Don't have an ingot mold? Carve a channel in a charcoal block **[1b]**. The channel must be wider at the top than at the bottom, or your cooled ingot won't come out easily.

Prepare the ingot mold. Lightly apply a bit of liquid bur lubricant or beeswax to lubricate the inside walls of your mold. (You don't need to lubricate a charcoal block, if that's what you're using.)

Alternatively, if your torch uses a gas that creates soot (such as acetylene), direct the flame at the mold to lightly coat it with soot; like flour on a cake pan, soot can help your ingot to pop out.

Determine the alloy and weigh the metal(s). Refer to the "Alloy Recipes" chart, to choose the alloy you'll create. Note the percentage of each metal you'll need and its melting temperature. The amount of alloy you make is up to you; you don't need to fill your ingot mold. Using a scale, weigh each metal (in scrap or casting grain form), keeping the metals separate **[2]**.

Melt the first metal. Wear green #5 tinted safety glasses to protect your eyes from the torch's bright flame. Place the bowl of your pouring crucible on a solid, heat-resistant surface.

Place the metal with the highest melting temperature in your pouring crucible **[3]**. Sprinkle a pinch of powdered casting flux on the metal to help keep it clean.

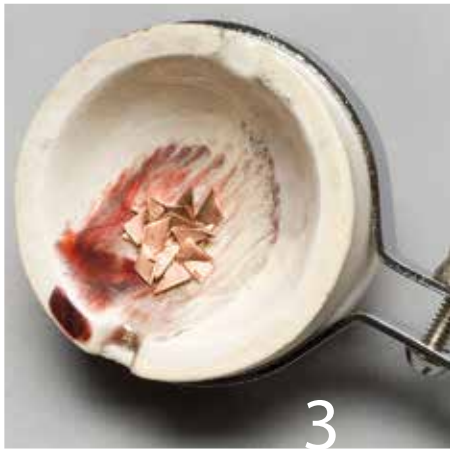
Adjust your torch's flame to a large, bushy, reducing flame, and bathe the metal in the pouring crucible in flame. Position your torch so the end of the flame's inner cone just touches the metal; the rest of the flame will curve up along the walls of the crucible's bowl, heating both the crucible and the metal.

Keep the flame moving continuously over the metal until the metal fully melts into a liquid. Carefully sprinkle a small amount of flux onto the molten metal.


1a


1b


2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brand new crucible?

You'll need to glaze your crucible before you melt any metal in it. This ensures that your metal doesn't stick to the ceramic bowl.

[A] First, remove your ceramic crucible from the handle attachment.

[B] Gently warm the crucible with your torch or in a kiln set to around 1500˚F (816˚C), until the ceramic is red hot.

[C] Remove the crucible from the heat, and sprinkle a generous coating of borax or powdered casting flux on the inside of the bowl. You don't want flux on the outside of the crucible, as it will stick to things when the crucible heats up, but be sure to coat the pouring spout(s). As the powder warms, it will bubble and enlarge slightly.

[D] Heat the crucible again with the torch or kiln; this will melt the flux into the ceramic crucible.

[E] Continue to alternately heat the crucible and add flux until there's a glassy coating on the inside of the crucible.

[F] Allow the crucible to air-cool. Once it's cool, attach the handle to the bowl; you're now ready to melt metal!

TIP: If you're not sure that your metal is fully melted, carefully jiggle the handle of the pouring crucible. Don't move the handle too much, or the molten metal could splash you. When all the metal moves easily (like mercury) without any lumps, it's fully melted.

Add the remaining metals. Once the first metal is fully melted, pull the torch back briefly and add the metal with the second-highest melting temperature to the crucible. Using the torch, melt these two metals together. Once they've melted together, repeat with your next metal, if necessary.

Sprinkle a bit more flux on your metal, and stir the fully molten metal with a carbon stirring rod **[4]**. (A carbon rod is best, because the molten metal won't stick to it.) Although carbon is a poor conductor, it will get hot as it contacts the metal; to avoid burns, work quickly and wear heat-protective gloves when stirring.

Warm the ingot mold. Warming the mold will prevent bubbles from forming in the ingot. Pass your torch over the mold, then immediately move the torch back to the crucible to keep the metal molten. (The lubricant in the mold may give off smoke; don't be alarmed!) Repeat several times in quick succession until the mold is warmed; the metal in the crucible should still be molten.

Pour the metal into the ingot mold. Lift the crucible and position it over the mouth of the mold. Keep the torch flame trained on the molten metal; unless the metal remains fully heated, it could solidify mid-pour and you won't achieve a complete ingot. Pour the metal into the ingot mold in one smooth motion **[5]**.

NOTE: I like to sprinkle a little bit of powdered flux on the freshly poured ingot to help prevent oxidation; I use a small copper spoon **[6]** that I made for this purpose.

Remove and clean the ingot. Allow the ingot and the mold to cool completely, then remove the ingot. Pickle the ingot to remove any leftover flux, and then thoroughly rinse it.

TIP: If the ingot doesn't come out easily, place the ingot mold in the freezer. A quick cooldown may help contract the metal enough that you can pop out the ingot.


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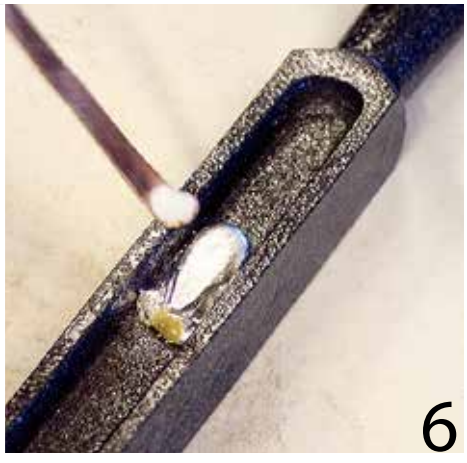
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So now I've got an ingot — what's next?

For a solid ingot, you need to fully compact the microscopic crystals of the metal. Place the ingot on a steel bench block. Use a flat chasing or planishing hammer to lightly hit the ingot on every side. The aim isn't to flatten it but to compact and condense it. Once you have your ingot, you can make it into sheet or wire.

To make sheet:
Use plain rollers in a rolling mill to compress the ingot to your desired thickness. Anneal the metal frequently to keep it from splitting on the sides.

To make wire:
Use the large (diamond-shaped) wire grooves on the rolling mill to initially compress the ingot. Pass the ingot through progressively smaller grooves; this will both reduce the diameter and increase the length.

To form the diamond-shaped wire into round wire, use a round drawplate (a thick sheet of metal with a series of tapered holes drilled through it).

Secure the drawplate in a bench vise with the smaller side of the tapered holes facing out. Using a hammer or the rolling mill, taper the end of the wire. Apply liquid lubricant to the largest hole in the drawplate, and insert the tapered end of the wire through the hole from the larger side.

Grip the end of the wire with drawing tongs or vice-grip pliers. Pull firmly and evenly on the wire, drawing its entire length through the hole. The compression and lengthening will heat the wire up considerably. Repeat the process, moving to progressively smaller holes in the drawplate until the wire is the desired gauge.

alloy recipes

To determine how many grams of each metal to use to make a given alloy, plug the percentages from the chart into the following formula:

Desired amount of alloy (in grams) x % of metal = g of metal

For example, if you'd like to create 20 g of sterling silver:

20 g sterling silver x 92.5% fine silver = 18.5 g fine silver
20 g sterling silver x 7.5% copper = 1.5 g copper

To check your math, add up the total grams of the alloy ingredients:
18.5 g fine silver + 1.5 g copper = 20 g total

NOTE: Use a scale that measures grams to weigh each metal separately. Use a jeweler's scale, not a kitchen scale, when measuring metals. Precious metals are weighed in troy ounces, which equal 31.1 g, whereas the ounces used for food and liquid measurement are avoirdupois ounces, which equal 28.3 g.

Make a batch of alloy mix* to keep on hand for alloying gold. When alloying gold, melt the gold first, then add the alloy mix, stirring thoroughly.

	METAL	Fine silver	Copper	Fine gold	Alloy mix*
	MELTING TEMPERATURE	1761°F (961°C)	1984°F (1085°C)	1950°F (1065°C)	N/A
Silver alloys	Sterling silver	92.5%	7.5%	—	—
	Reticulation silver	80%	20%	—	—
	Shibuichi	25%	75%	—	—
Gold alloys	Shakudo	—	96%	4%	—
	18k gold	—	—	75%	25%
	14k gold	—	—	58%	42%
	10k gold	—	—	42%	58%

*Alloy mix for gold is 55% copper and 45% fine silver.

troubleshooting your ingot

Ingot splits or crumbles — Impurities are present.

Uneven color — The metal wasn't mixed thoroughly.

Bubbles/cavities — Impurities are present and/or the ingot mold wasn't the correct temperature.