Plat/S+™
Innovative General Purpose Platinum Alloy transforming Goldsmiths into Platinumsmiths

Steven Kretchmer • Steven Kretchmer Design

Platinum has been the premier precious metal for jewelry since the development of the gas/oxygen flame. According to Platinum Guild International, platinum jewelry has increased in popularity over 700% during the past five years. Besides its beautiful color and feel, platinum jewelry is respected for its high-purity of 90% or more.

However, traditional high-purity platinum alloys, such as platinum-iridium or platinum-ruthenium, have been soft and are difficult to polish. The goldsmith who wanted to enter the more prestigious realm of platinum-work is sometimes baffled and intimidated by the different characteristics of the traditional platinum alloys. For many jewelers, platinum is extremely difficult to polish. The gummy alloys pack the goldsmith's files like annealed copper. Machinists need special cutting tools that are quickly consumed. Finishers have to emery progressively to super-fine polishing paper before special platinum polishing compounds can finally bring up a decent shine. The traditional platinum alloys also scratch, dull and dent easily. Thicker material must be used for strength. Labor costs and the cost of thick material have made high- purity platinum prohibitive for many consumers. Though the owner of platinum jewelry could admire their precious stones in the beautiful neutral color of platinum, they complain that the shine does not last, and the contrasting matte finishes quickly burnish away. The goldsmith needs a completely new attitude to platinum jewelry-making. Many goldsmiths simply backed away from the difficulties of working with platinum.

The commercial caster, too, has obstacles with traditional platinum alloys. High temperatures necessary to melt them also increased shrinkage on cooling and solidification. Therefore, porosity was frequently present. Flasks need to be held at very high temperatures or the molten platinum alloys that are flung into them would chill too soon. Recently, platinum-cobalt has been adopted for casters, due to its lower melting temperatures and its better flow characteristics. It has definitely reduced rejection rate and increased density of castings. Platinum-cobalt is magnetic, some say it has a chromium-like bluish color and oxidizes rapidly during brazing processes. Though it is somewhat harder than traditional platinum alloys, platinum-cobalt is still relatively chewy and difficult to polish.

In order for more manufacturers to enjoy working with platinum, it is appropriate to develop new platinum alloys. These alloys would have the characteristics that would include:

- A "crisp, dry" high-purity platinum alloy that filed and machined well, without destroying tools.
- It had to polish up like karat gold, and be hard enough to stay shiny.
- It should be hard, so that jewelry could be built from thinner wires and sheets.
- When stamped, hammered or forged, the final shape wouldn't dent.
- Yet, it had to be very malleable, but work-harden rapidly to become springy.
- The hardness of the platinum alloy should increase by heat-treatments after pieces were complete.
- It should cut and engrave cleanly, so beads and stitches could easily be raised for setting.
- It needs a springiness for clasps and pin stems, and slip, not grab.
- It should cast at a lower temperature, flow well and shrink less with low porosity and low oxidation on solidification.
- On melting, the alloy should not need additive refurbishing and should be non-toxic.

The desire for strength in an alloy is far from new. In our history of metallurgical developments, first there was copper, then there was bronze. The armies with bronze swords cleaved the copper swords in half, and those armies with bronze swords took everything from those with copper swords. Bronze is an alloy, made with copper, contaminated with tin. Copper is soft and tin is soft. But together,

Work Hardening Comparison To Traditional Platinum Alloys					
	Plat/Irid Plat/Ruth	Plat/S+™ 1	%	Vickers Hardness Plat/S+™ 2	%
Annealed	110-130	135-145	12%	170-200	54%
½ Hard	179	239	34%	275	54%
Full Hard	204	252	24%	306	50%
% of increased hardness is compared to platinum/iridium					

Casting and Flask Temperature Comparison		
	Plat/Irid Plat/Ruth	Plat/S+™ 1 Plat/S+™ 2
Melting Range	3227° - 3250°F 1775° - 1788°C	2912° - 2984°F 1600° -1640°C
Flask Temp Medium Weight Castings	1600° - 1700°F 871° - 927°C	1200° - 1400°F 649° - 760°C
Flask Temp Lightweight Castings	1700° - 1800°F 927° - 982°C	1400° - 1600°F 760° - 871°C

in certain concentrations, the resultant bronze can be very hard.

The metallurgy of alloying for hardness does not follow the simple rule of "add hard metal to metal to make hard." Iridium as a solid metal, for example, is so hard that it is best cut with a supersonic water jet, yet when added to platinum, does not harden it as much as we would like. Even tungsten added to platinum does not yield the hardness necessary.

A simplified way of beginning to understand the hardening of alloys could be by first understanding pure platinum as a crystal lattice, a mass of geometrically organized cells. The smallest individual cell unit of platinum is face-centered cubic (FCC). The platinum cell unit is structured as a cube with platinum atoms, pictured like Ping-Pong balls, at all eight corners, and a Ping-Pong ball on the center of all six sides of the cube. The cubic structure of the Ping-Pong balls wants to stay in a cube form due to the way the atoms are attracted to each other. A cubic cell unit of Ping-Pong balls is severely distorted when a Ping-Pong ball is substituted by a basketball (a basketball being of a significantly different diameter than a Ping-Pong ball). This distorted cell unit pushes against the cubes around it, jamming the crystal lattice. This is known as "distorting the crystal lattice of a metal by substitutional alloying," and is one way to harden a metal. This can be achieved by simple additives or by controlled heat-treatments that add energy to the system, vibrating atoms in and out, re-structuring cell units.

Another example of controlled hardening is by "ordering" that can be accomplished by having crystal lattices of different metals superimpose upon each other, also jamming each other's crystal lattice.

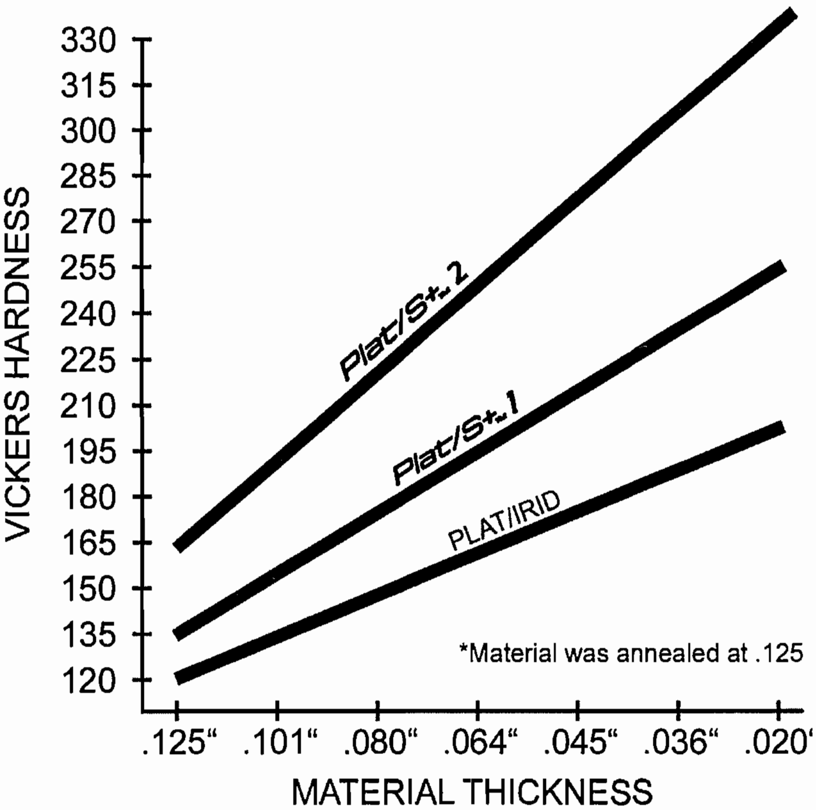
Maybe the most familiar hardening technique is "work hardening." It occurs when the cell units are smashed into each other by mechanical force, distorting and jamming the crystal lattice. These are only examples of hardening techniques, and techniques can be combined.

I have worked with exceptionally hard platinum alloys such as those I've developed for my tension settings, and began to research various formulas that would yield a hard, but more general-purpose alloy for jewelers. As my heat-treatable formula for tension settings are much too hard and springy for general purpose, I began to experiment with various series of derivations. I worked with other designers, who I knew would smash, bend, polish, set, melt and braze samples of possible formulas. I asked a platinum caster to run casting after casting to give me his detailed feedback, while using a platinum distributor's ounce after ounce for experimentation.

Finally, alloys had been developed, formulas tweaked to a thousandth of a percent and are on target. The patent is pending and the alloys are trademarked "Plat/S+™."

Needs have been met by these alloys This is an evolution in the development of platinum materials for the jeweler. Goldsmiths can become platinumsmiths overnight. Labor costs will decrease. Costs can be passed on to the consumer and she can finally have that high-purity platinum jewelry she could not previously afford, and the shine will last longer.

Plat/S+™ Work Hardening Characteristics



Plat/S+™ is a 95% pure platinum alloy. It is harder than traditional platinum alloys. This makes it more resistant to damage and wear. These characteristics also allow Plat/S+™ to polish much easier, reducing polishing time by at least 25%. The finish, polished or matte, will last longer. Plat/S+™ hardness and strength allows jewelers to use thinner material. This significantly saves on material cost without compromising the high-purity always associated with platinum jewelry.

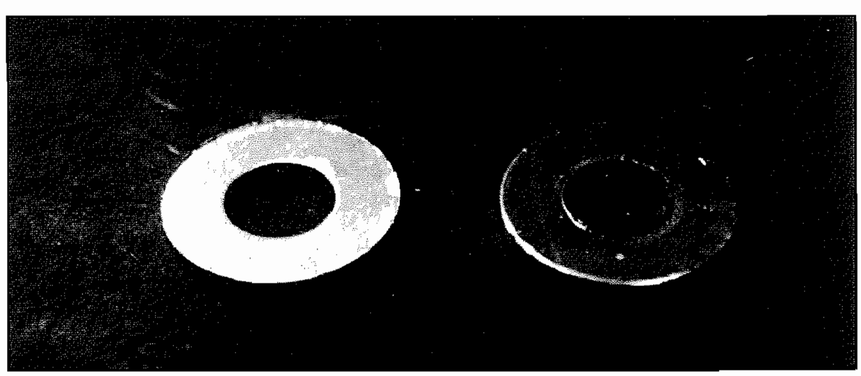
Plat/S+™can be work-hardened at a 25% faster rate and up to 30% harder than platinum/iridium. This alloy is also designed to be heat-treated to increase its hardness up to 50% from its annealed hardness.

It is easier to cast, unlike other platinum alloys that have been developed for hardness. It melts at about 250°F less than traditional platinum alloys. The alloy is also more fluid in its molten state, allowing easier fill of metal into the flask. The alloy does not need to be refurbished with other elements when remelted, and is non-toxic.

In the shop or factory, the superior characteristics of Plat/S+™ allow tools to cut cleanly and crisply, with much less tool wear. It machines and files without grabbing. Although harder, it can be rolled to one-third its thickness without needing an anneal.

Plat/S+™ is not for all purposes. It would not be used by manufacturers who need to weld in air by torch. Like gold alloys, it does not weld well without the use of plasma-arc or laser welders. Melting is best done by induction or hydrogen-oxygen torch, and casting, of course requires platinum investments. Due to the lower melting range of Plat/S+™ platinum solders of more than 1500°C should not be used.

Other than that, Plat/S+™ works by all techniques known to the goldsmith. It oxidizes when brazing, though much less than gold alloys, and fluxes should be used. To prevent oxidation when heat-treating, pieces made with Plat/S+™, they should be wrapped in



Washers are blanked out with only minor burring

HEAT TREATING *Plat/S+™* 2 (Vickers Hardness)	
Solution anneal 1800 F° / quench	1000° F 1 hour
186.0	**292.4**

stainless-steel foil or heated under shielding gas, like gold. Any oxides are quickly removed by light emery or polishing. Plat/S+™ should be kept separate from other platinum alloys that are used for welding in air, but can be mixed in with all platinum scrap for refining. Caution should always be taken regarding eye safety, and to not contaminate platinum alloys due to certain chemical reactions that occur at high temperatures while brazing.

Plat/S+™ is an excellent bridge for goldsmiths to become platinumsmaiths, and a high purity platinum alloy that many platinum manufacturers have been waiting for. Platinum technology is in its infancy. As the excitement, expectations, and demand grow for platinum jewelry design, we can look forward to seeing many innovations, improvements, inventions and discoveries with platinum materials and techniques.

Acknowledgments

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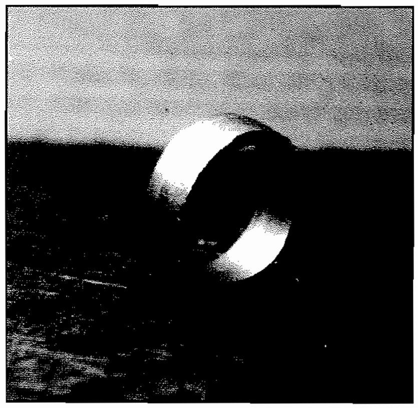
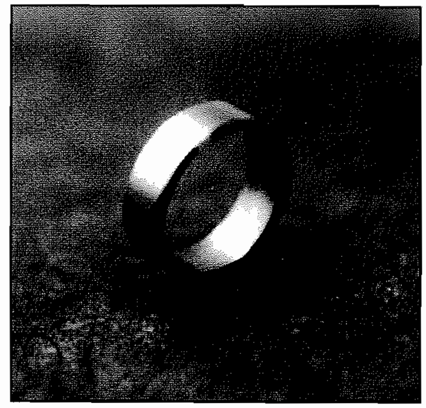
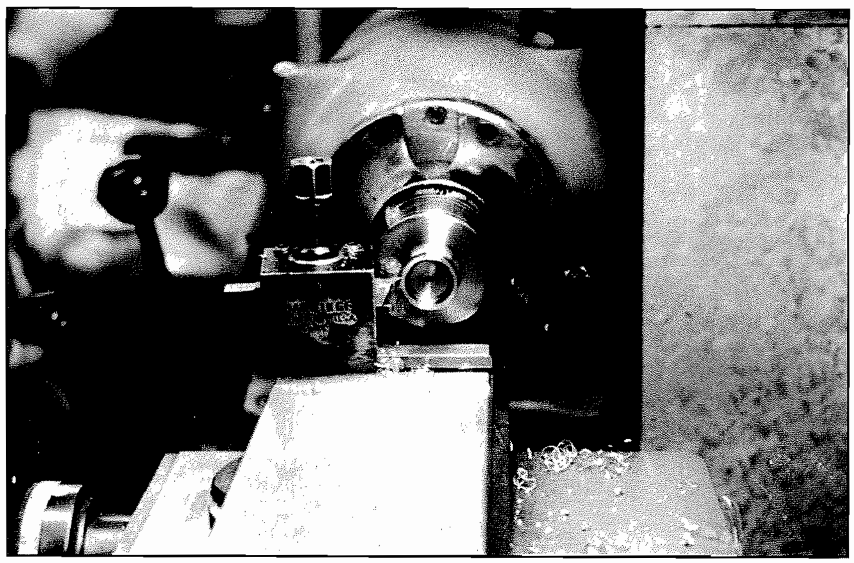


Reshaped into a short tube. No surface smearing



First cut on Lathe was clean and easy to perform



Machining

Radius cut for final shape

Polishing was easy and the result was smooth and bright.