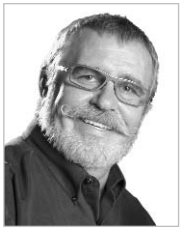
Platinum Alloys: Features And Benefits

By Jurgen J. Maerz, Director of Technical Education,
Platinum Guild International, USA



Platinum Alloys: Features and Benefits

Jurgen J. Maerz
Director of Technical Education
Platinum Guild International, USA
Newport Beach, CA, USA

Abstract

In the recent past, Platinum Guild International (PGI) has identified several issues relating to the improper use of platinum alloys for specific manufacturing methods. Rings made from soft alloys would scratch rapidly, some would deform, others would dent, and so on. The underlying cause of these issues can be addressed by clarifying which alloy is best suited for which function.

This paper will address the suitability of individual platinum alloys for different manufacturing methods, ranging from fabrication to casting, die striking to machining. Comparing hardness, strength and durability, the ideal platinum alloy is identified and recommended for the manufacturing method at hand. Specialty alloys and the use of them in manufacturing will also be addressed.

Keywords

Platinum, platinum alloys, iridium, ruthenium, cobalt, tungsten, palladium, casting, die striking, fabrication, scratching, denting, manufacturing, industry, PGI.

Introduction

Platinum is gaining popularity among jewelers in the United States and around the world. In the U.S. alone, the current demand is over 300,000 oz. Because of this popularity, more and more manufacturers are entering into the platinum manufacturing field. Many are coming from gold manufacturing and are experiencing manufacturing challenges, caused by the unique properties platinum has to offer. Many tried and tested manufacturing techniques will not work well with platinum. What is required is a knowledge of platinum alloys available, so that intelligent decisions can be made concerning which alloy to choose and how much impact that alloy will have on a current manufacturing technique.

I will discuss the platinum alloys that are available, their features and benefits, and the manufacturing methods and the type of jewelry these alloys are best suited for. Only a clear understanding of platinum and the proper use of

available alloys will guarantee that the end-user, the consumer, will enjoy his or her platinum jewelry for a long time to come.

What is Platinum?

Being one of the rarest and most precious metals on earth, platinum has a special place in the hearts of consumers. It has always been associated with value. Precious diamonds, such as the Hope diamond have been set in "the only metal fit for royalty." During WW II platinum was used as a strategic metal and was not available to the general public for use. This has changed and within the last 12 years, platinum consumption in the U.S. rose from 20,000 oz. in 1992 to the level it has reached today, topping 300,000 oz.

One can easily understand that many manufacturers want to take part in this market, considering that a high percentage of all wedding and engagement rings are made of platinum, and the demand is growing.

Platinum is soft. In its natural pure state the hardness on the Vicker Scale reaches only 40. That is not suitable for jewelry.

Denting, scratching and deforming will take place in a very short time, should one wear jewelry made from pure platinum. (For your information, I will mention that micro-alloyed pure platinum is available with a hardness of 120HV+, but these are specialty products and are mostly sold in Japan or Germany.)

Traditionally, platinum has been alloyed at very high purity. Most platinum used for jewelry in the U.S. is alloyed at a 900 or 950 purity level. This leaves only a small amount of room for alloying in order to change the hardness and other features. Platinum can be alloyed with many metals to achieve desired features. Platinum Group Metals (PGM) are often used for this, but more often than not, base metals, or a combination of them, will be the choice. Platinum can also be alloyed with gold. Commonly one can find iridium, palladium, ruthenium, copper, cobalt and tungsten alloyed with platinum. In some specialty alloys one can find gallium or indium as well. These specialty alloys have heat-treatable features, where platinum can be made as hard as (or harder than) steel, which opens up an entire new universe of applications, from tension settings to spring use.

Which Alloy to Choose

One of the first considerations when choosing a platinum alloy is the type of jewelry you are manufacturing. Is it a casting or hand fabrication? Is it die striking or are machining techniques employed? For each of these manufacturing techniques there is a platinum alloy that will give optimum performance. Some platinum alloys can be used for all manufacturing processes, while others are strictly for specialized use. The high-purity micro-alloyed platinum mentioned earlier can only be used in limited applications that require no heat. So it cannot be cast, welded, or soldered, for example, yet beautiful pieces can be made using sheet and forming dies.

The most common platinum alloys found in the U.S. are Pt900/iridium, Pt950/iridium, Pt950/cobalt, and Pt950/ruthenium. This is then followed by specialty alloys. The chart below shows hardness and strength of these alloys.

Table 1

Platinum Alloy	Hardness HV	Strength PSI
90/10 iridium	110 HV	55,000 PSI
95/5 iridium	80 HV	40,000 PSI
Platinum/cobalt	135 HV	64,000 PSI
Platinum/ruthenium	130 HV	66,000 PSI
Platinum/palladium	70 HV	37,000 PSI
Platinum/tungsten	140 HV	120,000 PSI
Pt 950/heat-treatable	160–330 HV variable	100,000 PSI +

Hardness is an important factor when choosing an alloy. The hardness in this paper is depicted in HV (hardness Vickers).

The hardness of an alloy is measured with a Vickers tester.

By applying a predetermined amount of pressure to a piece of alloy inserted into the machine, a small pyramid shaped piece of hardened steel or diamond is pressed into the alloy being tested. The resulting impression is then measured and the hardness can be read on the scale (see Figure 1).

Figure 1 *The resulting impression is measured and the hardness can be read on the scale*

Another important factor to consider about platinum is its wear resistance. Platinum will scratch and develop a patina over time, but it is very resistant to wear. These photos demonstrate this important feature. Both pendants have been worn for six years.

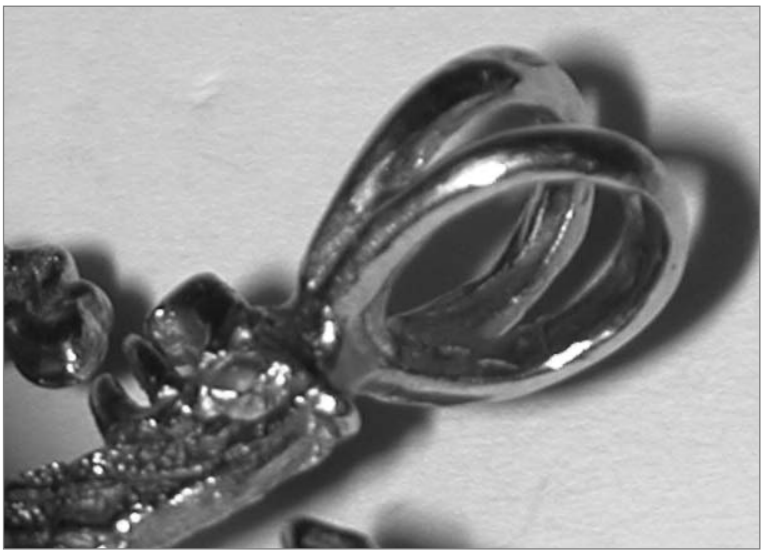


Figure 2 *Platinum bail with almost no wear*

Figure 3 *Similar gold bail with substantial wear*

A platinum chain worn daily will show very little wear even after many years. Chains made from other metals will wear through.

Lets look at the platinum alloys you will encounter when manufacturing. I will discuss each alloy and then make some recommendations as to the most suitable one for use.

Pt900/Iridium

Pt900/iridium has been the staple of platinum alloys in the U.S. This great alloy is 100% precious metal. It is specifically recommended for hand fabrication as it will work harden rapidly. Known as iridio-platinum, in the early 1900s this was the most commonly used platinum alloy in the U.S.

When iridium is alloyed with platinum, good solubility is achieved. At the 10% level, this alloy has a hardness of 110.

It is a good universal alloy and can be used with all manufacturing methods. The color is bright white and it is the most popular platinum alloy in the U.S.

Pt950/Iridium

This is a fabulous fabrication alloy. When forged, rolled, hammered, or stretched it will work harden rapidly. It can be welded and soldered. In its annealed form it is not very suitable for casting as it has low hardness.

A few years back, many casters would use Pt950/iridium for casting. The reason was two-fold:

1. They wanted an alloy that could be stamped with the word platinum. The law requires that the purity is at least 950/1000 for that stamp.
2. The price was right. A Pt950/iridium alloy was somewhat cheaper than other available alloys.

What was wrong with this choice was that the alloy Pt950/iridium has a Vickers hardness of only 80. The result was problematic. Castings would bend, shanks would deform and the rings would dent, scratch and show premature signs of wear. The solution to the problem presented itself, as the price of iridium rose tremendously. Suddenly other alloys became an option.

Pt950/Ruthenium

Pt950 ruthenium was less expensive. Many casters started to use this alloy. The castings were harder and the problems associated with Pt/950/iridium were all but eliminated. It is better to chose an alloy by the performance rather than the price. One of the trade-offs was that Pt950/ruthenium is more difficult to cast, and tends to form micro-porosity. In order to reduce porosity, this alloy needs to be cast at a higher temperature.

It is a truly universal alloy and is the preferred use for tubing and machining parts. If one is in need for economic and refining reasons to employ only one platinum alloy, Pt950/Ru is the ideal choice.

Pt950/Cobalt

When alloyed with platinum, cobalt acts as grain refiner, thus making fine detailed casting possible. When molten, platinum alloyed with cobalt is more wet and thus will fill better when cast. The hardness of HV 135 contributes to the castings as well. They are less difficult to finish and hold their shine for a longer period of time. Platinum alloyed with 5% cobalt will be slightly ferro-magnetic. It also will oxidize when welded or soldered above 1000°C. This is something some bench jewelers claim to have difficulty dealing with, but as more rings enter trade shops for sizing and other maintenance issues, the jewelers are getting used to working with Pt/Co and complaints are decreasing.

In recent comparisons between platinum alloys it was found that 95/5 Pt/iridium can be scratched and lose its surface reflectivity in a relatively short time. This is directly related to the low hardness. Work hardening will slow down the loss of polish dramatically. It is therefore recommended that jewelry made from 95/5 Pt/Ir should be decorated with surface engravings and other finishes that do not require high polish.

The same research shows that 90/10 Pt/Ir and Pt/Co alloys will hold a surface finish 2.1 times longer and 95/5 Pt/Ru will withstand the scratch test 2.36 times long than 95/5 Pt/Ir. Accordingly, 95/5 Pt/Ir should be used for products that receive low abrasion and where highly decorated surfaces can be employed, such as engraving. The alloys 90/10 Pt/Ir and Pt/Co are suitable for high-polished rings but 95/5 Pt/Ru is the best choice for wear resistance.

Pt950/Palladium

In many Asian countries, platinum/palladium alloys are the choice for jewelry manufacturing.

Palladium dissolves fully and easily in platinum forming what is called "substitutional solid solutions." This alloy has the same crystal structure as platinum. Platinum alloys containing palladium are all easily workable. However, they have a very low hardness and thus are not recommended for casting. They also tend to be somewhat gray in color and thus many manufacturers rhodium plate platinum. HV 65 is the hardness for this alloy and one can see that this can lead to consumer issues when rings are bending, denting and scratching. Sometimes the rhodium skin is very thick to keep the scratching issue down. This distracts

from platinum and gives it a different appearance. It is not recommended to rhodium plate platinum.

Often these rings are difficult to size, as they tend to break when spread for sizing and it is difficult to restore the plating once heat has been applied.

Figure 4 *A ring made from Pt/Pd soft alloy*

Figure 4 shows a ring made from a Pt/Pd soft alloy. Note that the ring is deformed and the stone has been lost.

Pt950/Tungsten

One of the popular Pt alloys for machining, especially in Germany, is Pt950W. This is not a casting alloy, but is usually supplied in tube form to the manufacturer, who then slices the tubes and creates wedding rings from the slices using Swiss machines, lathes, or other cutting machines. The alloy is hard and springy and has uses in some findings as well. This alloy is very strong and is used primarily for wedding bands.

Pt950/Heat-Treatable

This is a group of platinum alloys that are used for findings, tension rings, omega clips, and so on. The alloys are mostly proprietary and patent protected. When making earrings, for example, it is good practice to use platinum ear nuts that are made from heat-treatable alloy. They will continue to perform through the years. The same finding made from regular alloy will be loose and useless in a very short time.

Many other findings are made from these alloys. Many finding houses are making die strike heads from these alloys, as they will provide prongs that tend not to bend as easily as regular alloy prongs do.

Table 2

Pt Alloy	Casting	Fabrication	Die Striking	Machining
90/10 Pt/Ir	satisfactory	excellent	excellent	poor
95/5 Pt/Ir	poor	excellent	excellent	poor
Pt950/Co	excellent	good	good	good
Pt950/Ru	good	excellent	good	excellent
Pt 950/Pd	poor	poor	good	very poor
Pt950/W	n/a	excellent	poor	excellent
Pt 950/Heat-treatable	excellent	good	excellent	excellent

Best practice recommendation

Universal alloys are alloys that will do all manufacturing processes, such as casting, fabrication, die striking and machining. Table 2 above gives a quick, helpful overview.

Pt900/Ir

Is universal and can be used for all manufacturing methods. Care must be taken when using machining, as the hardness and characteristics of this alloy will require high tool wear.

Pt950/Ru

Is a universal alloy for all manufacturing methods. It is good practice to limit the use of alloys to one, if possible. This will make refining easy, as all the metal used is the same alloy. Pt/950/Ru is suited for all. Casting Pt/950Ru consistently, will require practice and understanding of the alloy. If your manufacturing strategy included only one platinum alloy, this one should be your choice.

Pt950/Co

While platinum/cobalt can be used for other purposes, it is primarily a casting alloy. If you want fine-detailed castings, Pt950/Co is the one to use. If you have an issue with the fact that it is slightly magnetic, you can use Pt950/Co/Cu and eliminate this concern.

Pt950/W

If you are making a machined wedding ring product and have had issues in the past with scratching and such, you might consider trying Pt950/tungsten.

Pt950/Heat-treatable

For specialty manufacturing, findings and such, heat-treatable platinum alloys offer a variety of options. Freely available versions of these alloys can be obtained from your metal providers.

Conclusion

Most of the issues identified with platinum jewelry can be traced back to the use of the wrong or less-suitable alloy. Problems like scratching and denting can be reduced by using a harder alloy. This can also reduce the occasional bending a ring can undergo when the alloy is not really the one that this ring should be made from.

There are also design considerations that will help reduce issues. That shank might not have bent if it had been a little thicker. Often rings are made originally in gold and are then carried over into platinum. This can be a source of discontent, as the ring was never designed to be platinum.

Armed with the proper information, a manufacturer can make platinum jewelry that will be cherished and treasured for years to come. Understanding the alloys, the features and benefits will help in this effort.

Remember: Platinum is not difficult. It is just different.

Credits

1. Greg Normandeau and David Ueno published in Platinum Manufacturing Process VIII
2. Kris Vaithinathan and Richard Lanam, Features and Benefits of Different Platinum Alloys, Platinum Day 2005