Heat Treatable Platinum for Jewelry

Klaus Wiesner, Product Manager • C. Hafner Gold & Silver Refining Company

PLATINUM- a material for making Best Sellers.

This is the slogan used by Platinum Guild International's German office to market Platinum. Because of its unique physical and technical properties, Platinum is an interesting material to work with. However, in its pure state it is too soft to be used for many jewelry application and therefore needs to be alloyed with other elements to create a hard, workable metal. Over the years many alloy combinations have been developed and are in use today.

Worldwide, the most common alloys have a purity of 950 parts per thousand. Upon examining the contents of these alloys, one realizes that there is usually only one additional metal involved. The hardness of these alloys range from 65-150 HV (Vickers) which is not especially hard.

For this reason, DEGUSSA created Platinum Plus in 1987. This was a three-component alloy and was demonstrative harder than the other two-metal Systems. In 1988, C. Hafner added a modified alloy with even a higher hardness under the name Platinum S. Shortly thereafter another variation of this alloy was introduced by Johnson Matthey-Brandenberger of Switzerland, Platinum XB SP 252.

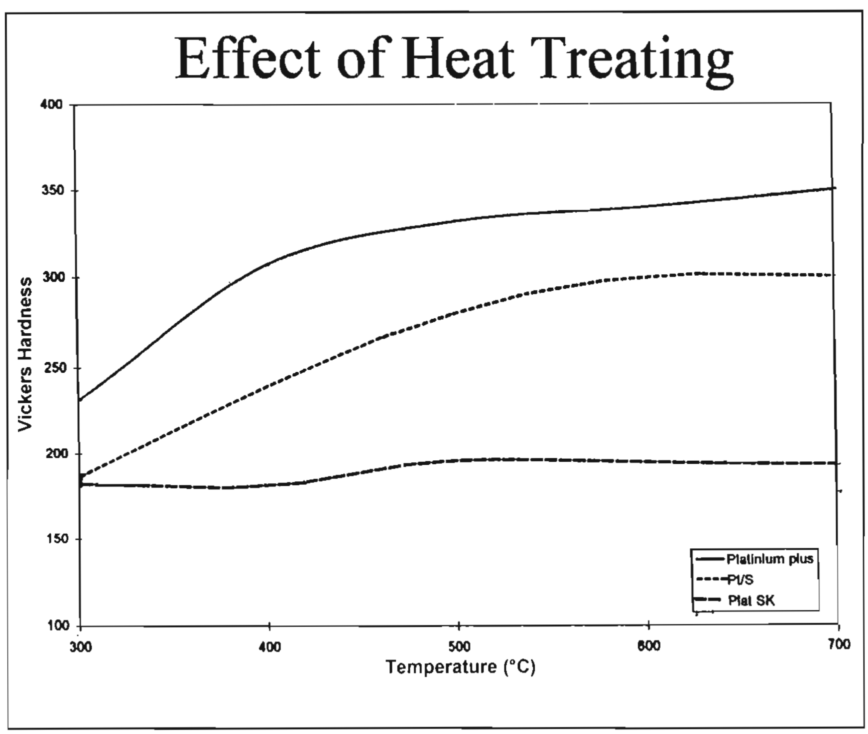
In 1998 Steven Kretchmer introduced Platinum St™ and marketed it through Hoover & Strong in the US.

These alloys all have very specific properties and are all ternate alloys. Three metals are needed to create such an alloy. As you can see from Table 1, even annealed and in a dead soft condition, these alloys are harder than the common ones. Another very important difference and feature is the fact that they are heat-treatable.

This property makes it possible to use these alloys in specific applications. Particularly in jewelry manufacturing, where the materials used are subject to high

Physical Properties of Platinum Alloys			
Alloy	Melting Range (°C)	Hardness, soft(HV5)	Density (gm/cm^3)
Feinplatin	1772	50	21,40
Pt/Cu960	1745-1730	110	20,30
Pt/Co950	1740-1730	150	20,20
Pt/Pd960	1760-1750	85	20,80
Pt/Ir 800	1830-1815	190	21,70
Pt/Ir 900	1800-1790	110	21,60
Pt/Ir 950	1790-1780	80	21,40
Pt'w 950	1845-1830	155	21,30
Pt/Ru950	1795-1780	125	20,70
PlatinumPlus	1660-1600	165	-
PlatinS	1600-1510	220	19,70
XBSP252	---	200	---
PlatS+1™	1640-1600	135-145	---
PlatS+2™	1640-1600	170-200	----

demands, heat-treatable alloys can be used by taking advantage of these special properties. These features are not necessarily in competition with conventional alloys, but serve as an additional tool to create a better product and to realize new designs. These new



Graphic 1. Effect of Heat Treating

innovations in Platinum help in keeping PLATINUM- a material for making Best Sellers.

How does heat-treatment work?

Heat-treating is only possible if a base metal can solve alloying elements with rising temperature. At quenching, an over-saturated solution is created. This solution will expel small particles into the metal mix which creates a tighter metal structure and thus creating the harder alloy. (similar to condensing water) In jewelry making practice, this means, that the metal is heated through welding, soldering, annealing, and then during a slow cooling cycle, this expelling mechanism of small particles will create a much denser and harder alloy. Platin S is able to reach 360 HV.

Optimal Hardening Parameters for Alloys			
	Annealing	Hardening	Hardness
Platinum Plus	900-1000°C Water	30 min 500°C/Air	220
PlatinS	1000°C Water	30 min 700°C/Air	350
PlatS+TM	980°C Water	60 min 540°C/Air	290
XB5P252	1000°C Water	60 min 650°C/Air	360

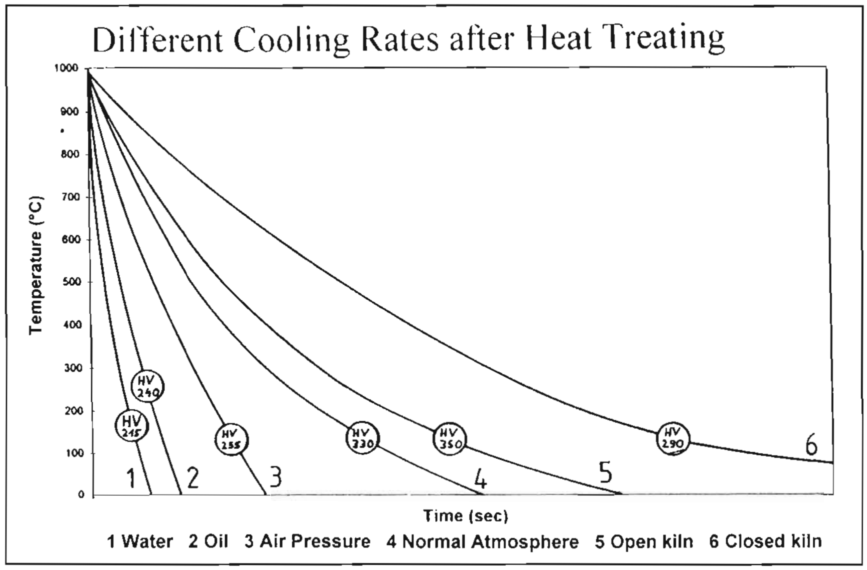
The advantages of these alloys are:

For the finishing process:

- A high basic hardness for the alloy
- No loss of hardness during soldering/welding
- Additional hardening after fabrication
- Alloys do not grease
- Ease of workability, filing, polishing
- Easy and faster to polish
- Good castability
- Ease of milling

For the product:

- Highly dense pieces
- Scratch resistance



Graphic 2. Different cooling rates after heat treatment

- Hollow jewelry with thinner walls possible
- Filigree Platinum jewelry are possible
- Reduced jewelry weight
- Spring elements can be made at a better price
- Springiness does not relax
- New design and manufacturing possibilities

Disadvantages of these alloys:

- Oxidizing during heat operations such as soldering
- Because of lower melting points conventional alloys cannot be used for welding
- Welding solders cannot be used
- Not useable for deep drawing

Graphic 1 shows the dependence on temperature to obtain maximal hardness in an alloy.

Graphic 2 shows the dependence on the cooling media. Here you can see the importance the cooling speed has in relation to the

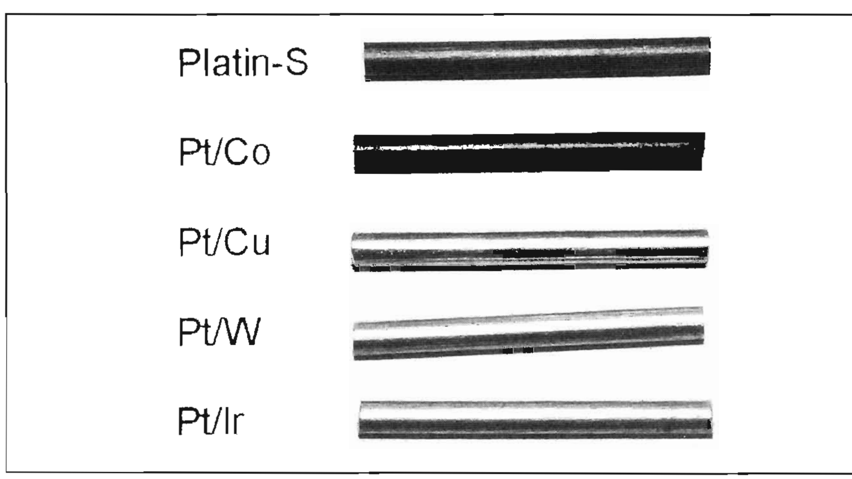
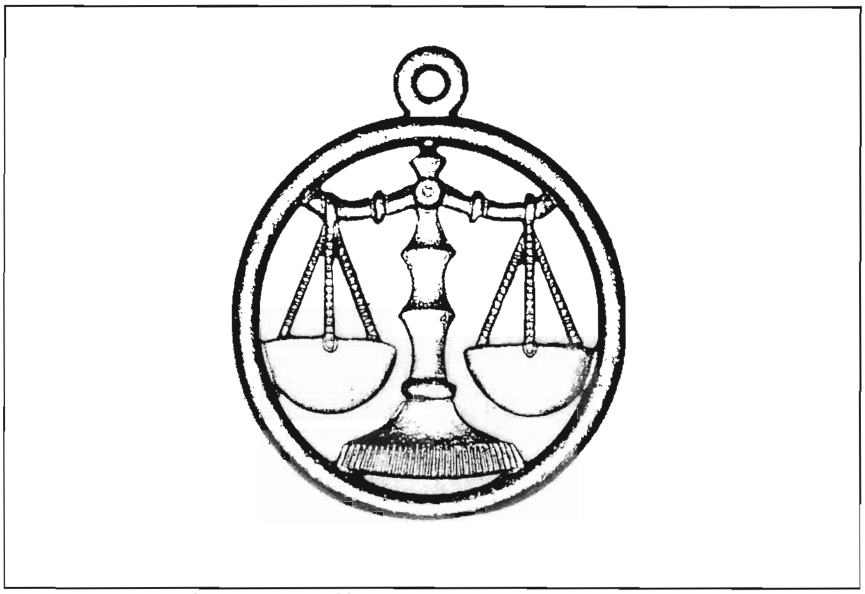


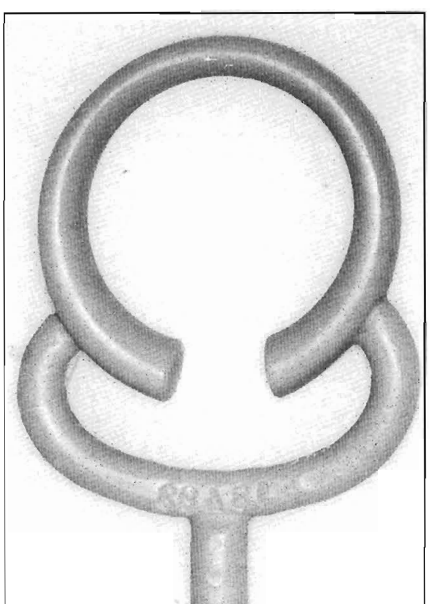
Photo: Oxidized wires after annealing

hardness achieved. A small increase of hardness is taking place during air cooling. The largest increase in hardness is achieved when the metal is annealed to full softness in a kiln, water quenched and oven treated for 30 minutes at 500-700°C depending on the alloy.

To protect jewelry parts from oxidizing, we recommend them to be covered with one of the available protective solutions, such as Cehaflux or Platin-Clean. Because of the fabricating techniques used, an oxidation on these pieces can not always be prevented completely. In this case it is possible to clean the alloy with a soft flame. This can also be accomplished in a kiln with a protective atmosphere.



Example 1: Cast Platinum part, filigree



Example 2: Cast Platinum part, tension ring

As matter of principle, there should be no more work done on a piece after it has oxidized, unless the surface oxidation is removed and the piece is shiny. Oxidation entering the metal trough drawing, rolling and such are very difficult to remove at a later stage. The following examples will demonstrate the advantages of heat treatable alloys and the application in jewelry making.

Example 1: Cast Platinum part

Objective:

Casting of small detailed filigree parts, (thinnest sections in picture below are oval 1.30x1.10mm and round e 0.45mm with 8mm length)

Problems:

Casting thin sections, stability of castings.

Casting parameters:

Platin S

Flask temperature :	800°C
Investment:	R&R
Cast temperature:	1800°C
Casting machine:	Linn, Platicast

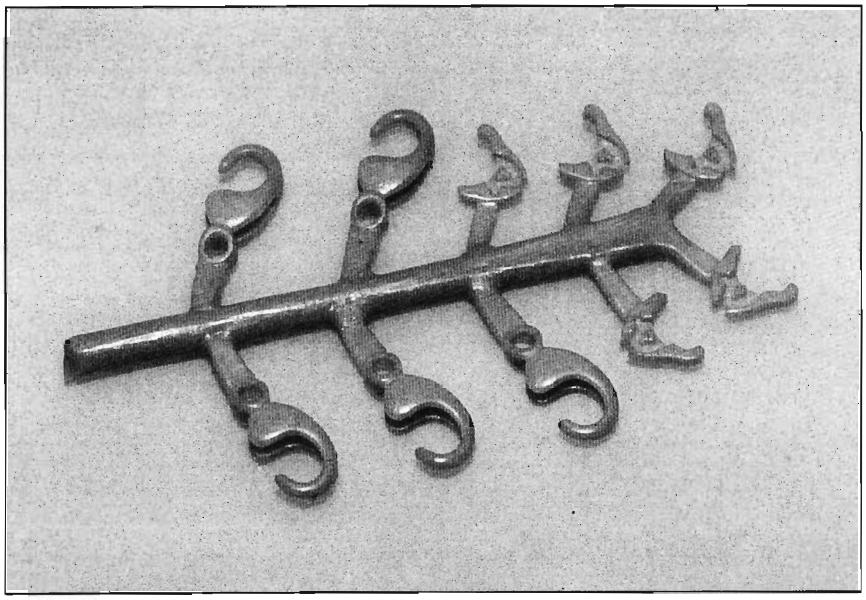
Result:

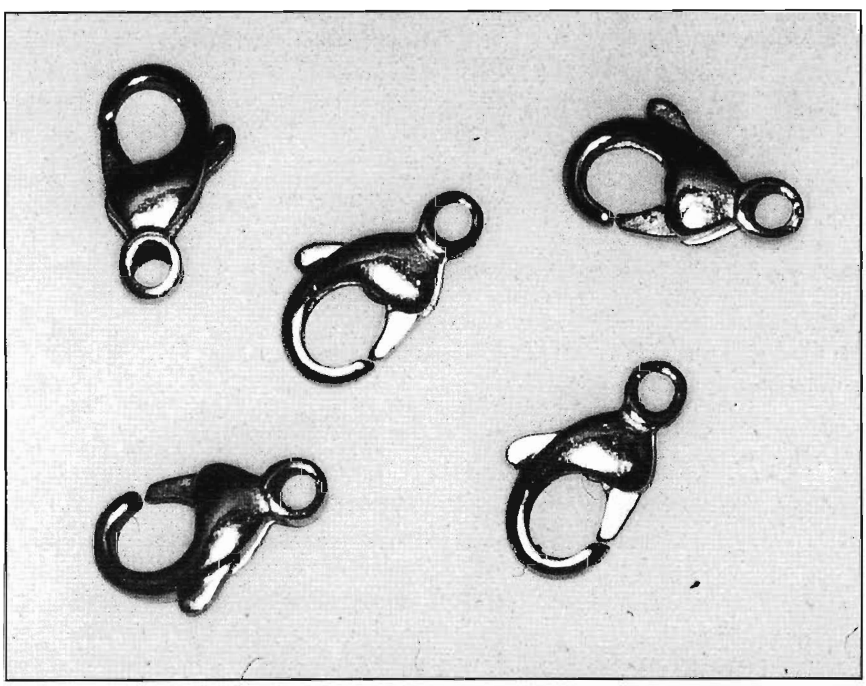
Part hardness as cast: 245 HV, after heat treatment: 320 HV. Exact reproduction with great detail. Strength and stability of cast part. No tearing of the investment. Less energy cost. Longer crucible use.

Example 2: Cast Platinum part

Objective:

High strength springiness. (this ring is usually made by forging and temper is created by work-hardening)





Example 3: Photos of Cast Platinum parts, lobster claw finding

Casting parameters:

Platin S
Flask temperature: 650°C
Investment: R&R
Cast temperature: 1750°C
Casting machine: Linn, Platicast

Result:

Part hardness as cast : 260 HV, after heat treating: 320 HV
High tension. No metal fatigue

Example 3:

Cast Platinum part

Objective:

High stability in the bend.

Problems:

None, but a better functioning of the finding was possible.

Casting parameters:

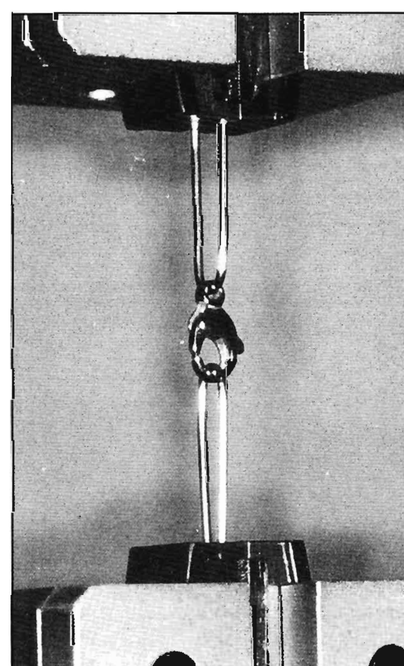
Platin S

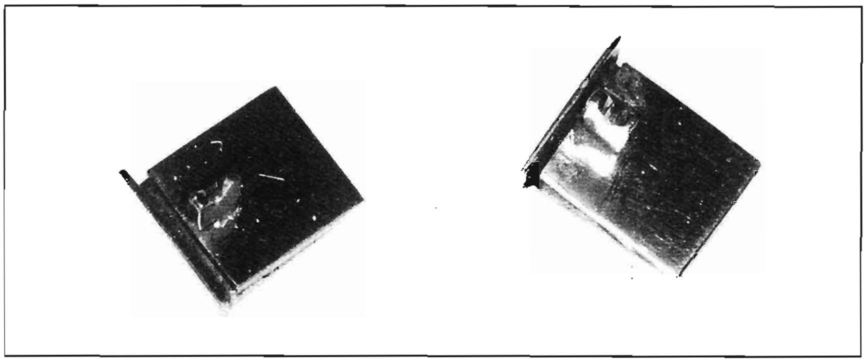
Flask temperature: 800°C
Investment: R&R
Cast temperature: 1800°C
Casting machine: Linn, Platicast

Result:

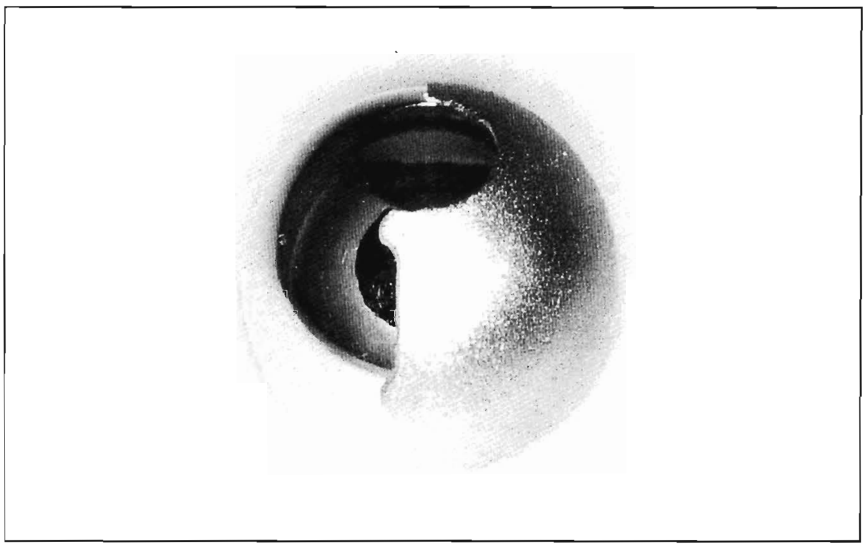
Tension strength of the clasp at maximum.

	Platinum/Copper	Platin-S
without heat treatment	88 - 94 N	140 - 160 N
after heat treatment	---	173 - 185 N

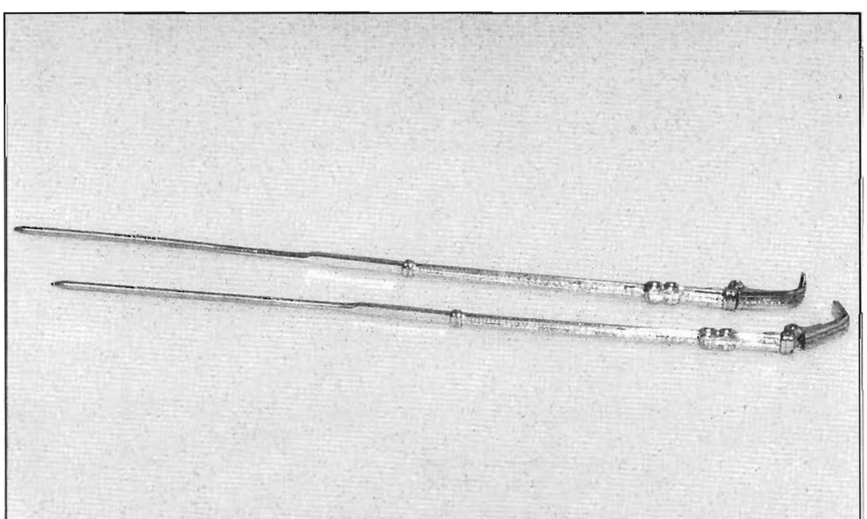




Example 4. Box clasp fitting



Example 5. Hollow body, sphere



Example 6. Eyeglass Frame

Example 4

Box clasp finding

Objective:
High non fatiguing tension.

Problems:
Clasp insert, bend from sheet will lose tension after short usage.

Alloy: Platin S.

Result:
Testing documented a much improved springiness, load cycle 3 times higher than by convention Platinum alloy with Copper.

Example 5:

Hollow body (sphere)

Objective:
High stability, lightweight.

Problems:
Soldered or welded hollow bodies made of Platinum have little hardness.

Alloy: Platin-S

Result:
After heat-treatment, hardness at 345 HV.
Very great stability with a wall thickness of 0.2mm.

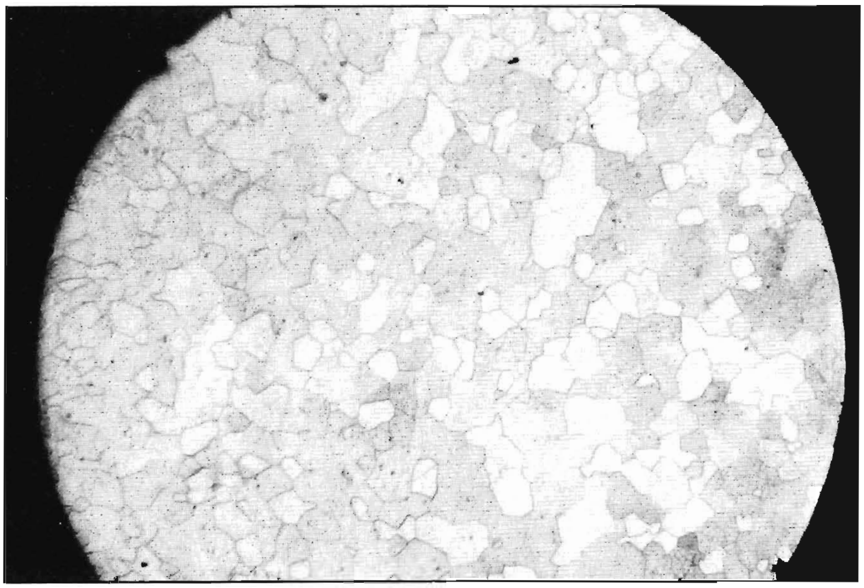
Example 6:

Eye glass frame

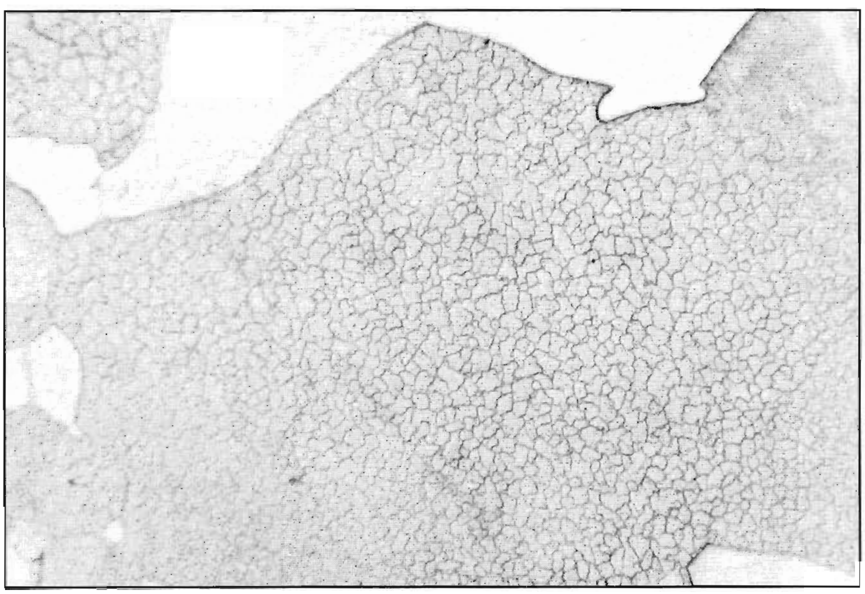
Objective:
High , non fatiguing springiness (normally not made of Platinum)

Alloy: Platin-S

Result:
Hardness after heat treatment at 350 HV. High springiness of the frame achieved by additional heat treatments. No metal fatigue.



Cross Section of Platinum-S, soft annealed (30:1)



Cross section of Platinum-S, after heat treating (500-1)

Conclusions:

The hardening of Platinum alloys can be a great advantage to the jewelry production. Unfortunately, it is not being used to its full potential. This may be because heat treatable alloys are relatively new and not all jewelers are aware of them, or the technique of heat treating is not that well known.

If one studies this subject, it becomes apparent that these methods and alloys make new jewelry designs possible and provide a wider spectrum in manufacturing options. The above examples should give inspiration to try this application in jewelry manufacturing.