

Is a Metal a Metal?

By Bruce Spivack, Aurident, Inc.

Too often we hear that laboratory owners buy a dental alloy based solely on its gold content. As we all know, virtually all dental alloy manufacturers offer compositions with gold contents that range from over 99% down to 0% for some ceramic alloys. But the question remains, is the gold content all that matters in selecting an alloy composition?

The answer is an emphatic no! One must carefully consider the entire alloy composition regardless of price and gold content.

Manufacturers add controlled amounts of different precious and non-precious elements to dental alloys in order to custom tailor their physical, mechanical and chemical characteristics for specific applications. In some situations, even extremely small amounts of an alloying addition can have a substantial effect on properties. For example, minute quantities (sometimes only 0.01%) of platinum group elements such as iridium or rhodium may be included in an alloy as a grain refiner. The resulting alloy will have a finer grain structure (i.e. smaller average grain size) than a comparable alloy without a grain refiner. Grain refining will enhance certain mechanical properties. Thus, a grain-refined alloy generally will exhibit increased ductility, usually measured by elongation, and consequently, be resistant to inter-granular cracks, commonly referred to as heat tears, upon cooling from the casting temperature.

With the recent decreases in the cost of palladium, more laboratories are being attracted to palladium-based alloys instead of gold-based alloys. But both palladium and platinum are also commonly used as alloying additions to gold alloys, because they increase the melting temperature of gold, making it suitable for porcelain bake-on applications, and also significantly harden and strengthen gold.

The effects produced by platinum and palladium as alloying elements, however, are not identical. Although both elements will lighten the natural, deep yellow color of gold, platinum will do so to a lesser extent than palladium. Thus, it is possible to preserve some of the deep yellow color of gold and also have the high temperature strength required in a ceramic alloy by using platinum instead of palladium as the principal alloying element. Other benefits, such as a lighter oxide and improved castability may be realized when platinum is substituted for some or all of the palladium. Obviously, since platinum is more expensive than palladium, the cost of an alloy containing platinum will be correspondingly higher.

What is the benefit to you the user? Basically, you have better control over what you fabricate by knowing its properties beforehand. If you are unaware of the properties of your alloy, be sure to ask your sales representative to help in your alloy selection.

Occasionally, technicians encounter problems casting metals. When we inquire as to the procedures being used, we find that many technicians use the same equipment and techniques regardless of the metal. All alloys should be melted with a slightly reducing

flame (a flame with an inner core approximately $\frac{1}{2}$ inch) to minimize excessive oxidation, which can adversely affect alloy properties. It is also important not to overheat the metal by leaving the torch flame on it after the metal has been heated to the proper casting temperature. Overheating will cause the constituent elements that are volatile or have volatile oxides to vaporize, thus changing the composition of the alloy. A secondary effect of overheating is excessive absorption of hydrogen and oxygen by the alloy from the torch flame. These interstitial elements concentrate in the grain boundaries of the cast metal, causing it to be more brittle than a properly made casting. To reduce cumulative effects of metal that has been cast more than once, some new alloy should always be added to a previously melted metal button.

Finally, correct use of crucibles is critical to assuring quality and consistency. Separate crucibles should be used for each alloy in order to avoid cross-contamination. There are also instances where technicians use their crucibles for an excessive amount of castings before discarding them. Crucibles that appear unusually glassy, or dark and eroded can contaminate the alloy being melted in it and cause potential difficulties.

Well, is a metal truly a metal? The answer to that question depends on the alloy used and how you treat the alloy during casting. Be educated in your purchasing decisions regarding the alloy. As strange as it seems, sometimes paying a premium for an alloy can result in lower costs in the long run. Precautions in procedures and equipment used to cast the alloy can result in more consistent and better castings. By following some of the simple rules outlined above will assure that your laboratory will produce the highest quality castings time after time. Being knowledgeable about alloys and their correct processing techniques will reduce the amount of remakes, thus saving you time and money.