

## Advantage and disadvantage of small alloying addition:

### Introduction

Standard yellow gold alloys which are based on gold-silver-copper can be used for many production processes. They could be called 'all-purpose' alloys. However, optimising the alloys for the particular manufacturing process to be employed is possible by use of other alloying additions which can influence relevant properties such as castability & grain size as well as the mechanical ones, for example, strength, hardness and ductility.

Only a few elements (e.g. zinc, silicon, iridium, cobalt) have proved to be useful additions for modifying carat gold alloys without detrimentally changing other relevant properties (e.g. colour). The present paper deals only with yellow carat gold, particularly 14 and 18 ct alloys. In the case of very high carat alloys, other modifications must be made to improve the properties. White gold alloys, with their more complicated composition, are a different problem & are not discussed here.

However, all such alloy modifications have to be performed with care. They can confer not only advantages but also disadvantages. Improper use causes defects. The influence, both advantageous & disadvantageous, of the more frequently used additions will be discussed. All elements which are added to standard gold-silver-copper alloys are considered as 'additions', independent of their concentration.

### Properties of carat yellow gold alloys

Alloys based on the gold-silver-copper system can be used for almost any purpose in jewellery fabrication e.g. investment casting, rolling sheet, drawing wire, deep drawing, stamping and chain making. They show an easy machinability.

Another advantage is that the only constituent which forms oxides is copper (cupric & cuprous oxides). Copper oxides are not very persistent. If formed, they can be easily reduced & oxidation can be

avoided by relatively simple methods.

In spite of these advantages, improvement of the alloys is necessary to meet the more demanding requirements of modern production methods and increased demands of customers. Since the late 1970s, many investigations for the development of improved alloys have been performed and the influence of small alloying additions on different types of alloys studied (1-4).

In the following sections, such additions will be roughly classified by effect and purpose:

- Improvement of castability (fluidity, form-filling)
- Prevention of scaling
- Deoxidiser
- Grain refiner
- Strengthener

### Difficulties with additions

Speaking about applications of additions and their advantages & disadvantages, it might be useful to use the terms which are familiar in terms used for medicines, such as:

- Application
- What is the correct dosage?
- Effects and side effects
- Recommendations for application

It should be stated clearly that no effect of additions exists without there being some degree of a side effect which might be detrimental. Also, an often neglected fact is that a positive effect can only be achieved if the correct dosage is used and the range of application is taken into account. Each addition makes the standard alloy somewhat more complicated and modified working conditions may be necessary.