Separation of silver present in the X-ray films for use in the manufacture of jewelry

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Abstract

This work aimed to study the efficiency of recycling the silver present in X-ray films for the development of alloys that can be used to make jewelry. For the recovery of metallic silver we used the chemical precipitation method which was used solution of NaClO and water in different ratios (Method 1 and 2) and NaOH and water (Method 3). The metal silver obtained from the three methods was analyzed by X-ray diffraction. The purity of the metal obtained was 94% that can be used in making alloys for jewelry. Furthermore, it was found that the method 3 is more economical than the methods 1 and 2. The choice of alloy's elements took into account the physical and mechanical properties for the manufacture of a ring. The alloys developed in this work were AgCuZn and AgZnAl.

Keywords: silver, metallic alloys, recycling.

1. Introduction

Silver (Ag) and other precious metals are used to make jewelry, being connected with other metals to give them a higher hardness and color required. The alloy most used to make jewelry is silver / copper. However, the major problem for silver alloys is its oxidation in contact with air changing its color getting yellow or blue or black and other colors [1].

Silver is also widely used in other sectors being the main responsible for their consumption photography, radiography, stock exchange investment (SEI), manufacture of coins, electronics, automobilist industry and galvanoplasty [2]. Its wide use also implies its disposal to the environment [3] which may cause contamination of soils and groundwater, depletion of landfill, among other factors.

The importance of recycling this metal occurs because like all heavy metal, has a cumulative effect in the body causing kidney, motor and neurological problems [3].

This work aimed to study the efficiency of recycling the silver present in X-ray films for the development of alloys that can be used to make jewelry.

2. Materials and Methods

Silver was obtained from the recycling of X-ray films collected at the University Hospital Cassiano Antônio Moraes (HUCAM). The recycling process occurred in four steps: Step 1 - submerging the films in solution to remove the gelatin containing silver. Three different solutions were tested: NaClO 2-2.5% and water in the ratio of 3:2 l (method 1); NaClO 4-6%, and water in the ratio of 3:4 l (method 2); NaOH 96.98% and water in the ratio of 1.000:10 g (method 3). Step 2 - decantation and filtration. Step 3 - heating the sludge with sucrose and NaOH at 180 °C for 30 min. Step 3 was performed using only the sludge obtained by the methods 1 and 2. Finally, in step 4, the product was heated at 1200 °C in a furnace for 3 hours with Borax ($Na_2B_4O_7 \cdot 10H_2O$).

The product obtained after steps 3 and 4 were analyzed by X-ray diffraction. The phase identification was performed using the database of the International Centre for Diffraction Data (ICDD) PDF-2 [4].

The choice of alloy's elements took into account the physical and mechanical properties for the manufacture of a ring, which must have high elongation that can be

formed and high yield strength that they do not deform during use [5].

Then, the alloys were developed at work: AgCuZn and AgZnAl.

3. Results

The diffraction pattern after step 3 (Figure 1) showed that only the sludge obtained by the method 3 contain sulfur (S) and silver sulfide (Ag_2S). This difference in the composition of the sludge did not interfere in metallic silver obtained after step 4 as shown of the diffraction pattern (Figure 2). The silver achieved 94% of purity.

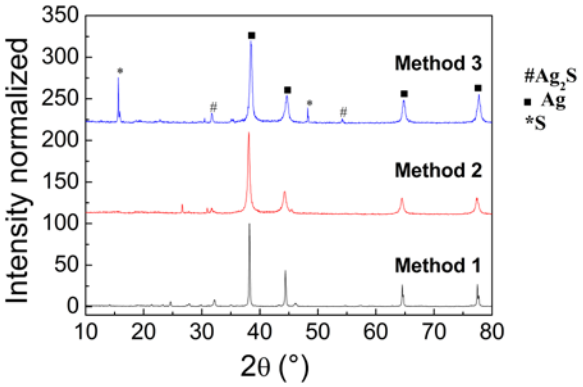

Figure 1:X-ray diffraction pattern after step 3

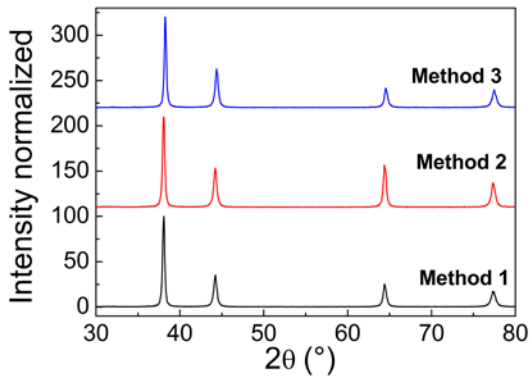

Figure 2: X-ray diffraction pattern after step 4.

The methods used were shown to be feasible for the recovery of metallic silver and to be low cost, allow its implementation in any laboratory. But method 3 was more efficient, more economical and less labor intensive than the methods 1 and 2 as shown in Table 1.

Table 1: Amount of metallic silver obtained from 1 Kg of X-ray films

Method 1	Method 2	Method 3
3,6 g	3,7 g	6,2 g

The ratio of the elements in the alloys developed were Ag85%Zn10%Cu5% and Ag85%Zn10%Al5%.

The alloys obtained were easy to be work owing to its low melting temperature and, lightweight. Apparently, they have good resistance, metallic luster, malleability and ductibilidadde. However a more detailed study should be done about these properties, as well as the corrosion resistance of these alloys can be determined more accurately.

4. Conclusion

We concluded that the silver recovery using NaOH is more efficient and the use of metallic silver obtained by recycling the X-ray films is feasible for making alloys for the manufacture of jewelry, since that is done a study more detailed of physical and mechanical properties of these alloys.

5. Acknowledgment

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6. References

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