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(CASE REPORT)

Forensic morphological and elemental analysis of gold jewellery: A case study

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Abstract

In a cheating case, report was launched in the police station of Raipur city of Chhattisgarh state. In this case, a person was cheated in buying gold beads worth nearly 16 lakhs. As in forensic physics branch analysis and comparison of physical properties is done, case was registered in state forensic Science Laboratory, Raipur. The aim of this paper is to understand and apply basic principles of physics to solve unsettled cases and create awareness, whenever we purchase precious ornaments.

In this case, a garland consisting of large number of round golden beads was received for examination of gold content assuming it to be gold of lower purity. Scanning Electron Microscope (SEM) examination, Energy Dispersive X-ray analysis (EDAX) examination of these beads were done in the laboratory. The results were supervising that there was no Gold (Au) in all the golden beads of garland, it consisted of Copper (Cu) and Zinc (Zn) in the ratio of Cu: Zn::2:1.

Keywords: Energy Dispersive X-ray (EDAX); Scanning Electron Microscope (SEM); Elemental Analysis; Gold (Au)

1. Introduction

Gold is the most precious metal among others. It is utilized in jewellery, coins, art work, and watches [1,2]. The common people have been fascinated with gold jewellery for thousands of years. India is the second-largest consumer of this metal in the world, and rural areas, where jewellery is a customary way to keep money, account for two-thirds of India's gold demand [3]. According to records, crimes including theft, fraud, and even murder are done in order to obtain such expensive metal. It is frequently claimed that gold has been stolen from jewellery by cleaning and combining it with other metals [4-5].

This paper presents an important case study related to forensic identification of gold and its purity estimation. The case considered is related to a cheating case registered in one of the police stations of Chhattisgarh state.

2. Case Details

In this case, some people sold garlands of golden beads to the victim by telling him gold beads. Hence the case was registered to local police station and the evidence was received by the state forensic laboratory. In this case, the aim was to examine the gold content of gold beads and also perform purity estimation of the gold.

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3. Methods and Materials

The garland consisting of large number of round golden beads was received for examination and marked as exhibit A in the laboratory. In order to perform the forensic analysis for identification of gold content and its purity. Scanning Electron Microscope (SEM) examination, Energy Dispersive X-ray analysis (EDAX) of beads available in exhibit A was carried out in the laboratory [6]. Two samples of beads received have been prepared from exhibit A and inserted to the SEM for the analysis. The morphological structure of the beads obtained from the SEM is shown in Fig. 1.
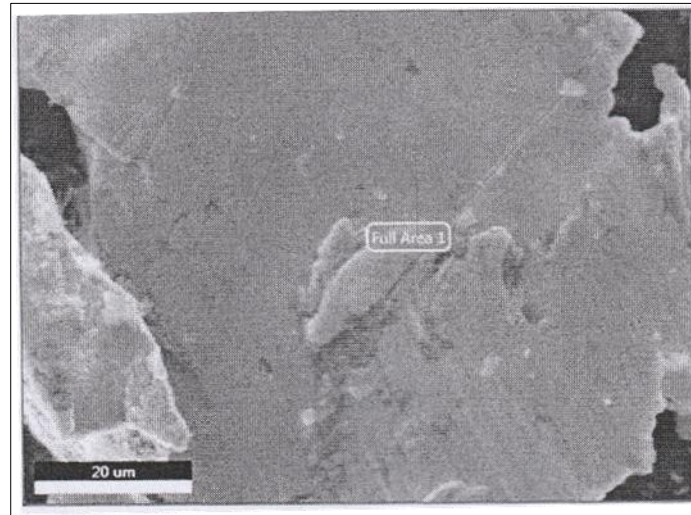

Figure 1 Surface morphology of beads of exhibit A

 In the next step the elemental analysis of the samples of beads have been performed using Energy Dispersive X-ray analysis (EDAX) system to analyze the elements present in the sample and their percentage. After the complete EDAX analysis, the resultant elements obtained from the two samples of exhibit A are shown in Fig. 1 and Fig. 2 respectively.
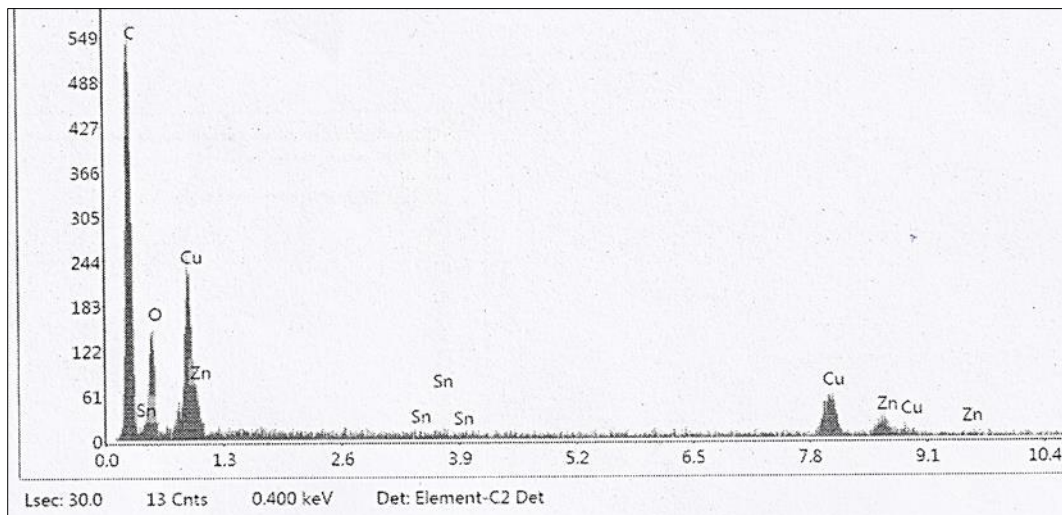
Figure 2 Elements present in first gold beads sample of exhibit A
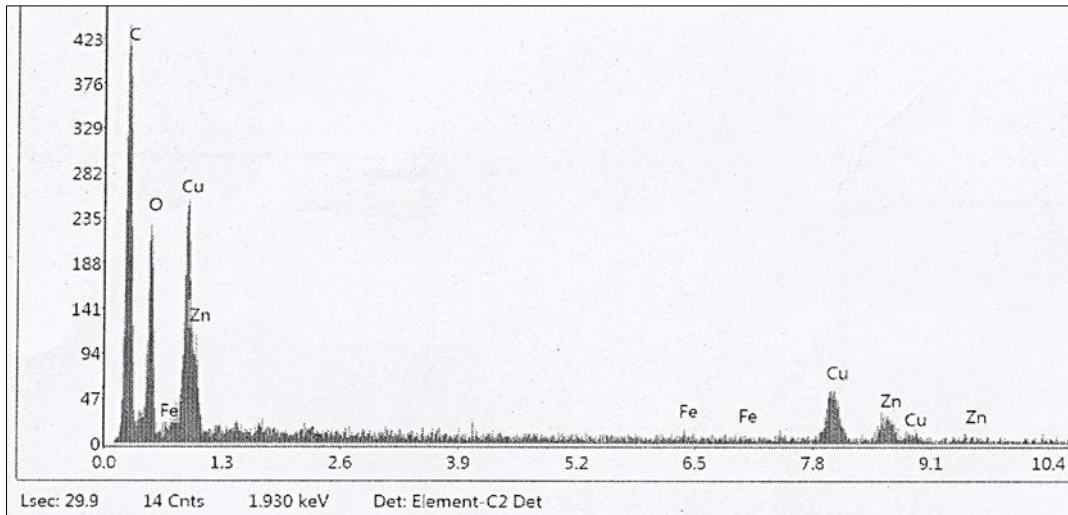
Figure 2 Elements present in second gold beads sample of exhibit A

The quantitative percentage of elements, shown in Fig. 2 and Fig. 3 are also tabulated in Table 1 and Table 2 respectively for the proper quantitative estimation.

Table 1 Elements and their respective percentage available in the first gold bead sample of exhibit A

Element	Weight %	Atomic %
Carbon (CK)	48.30	9.62
Oxygen (OK)	24.12	12.05
Iron (FeK)	0.88	48.71
Copper (CuK)	**16.34**	**8.73**
Zink (ZnK)	**10.35**	**12.07**

Table 2 Elements and their respective percentage available in the second gold bead sample of exhibit A

Element	Weight %	Atomic %
Carbon (CK)	55.58	9.03
Oxygen (OK)	17.98	13.04
Iron (FeK)	0.28	61.09
Copper (CuK)	16.77	7.41
Zink (ZnK)	9.39	11.79

4. Discussions

The obtained results clearly reveals that there is no gold (Au) contents in the gold bead samples of exhibit A. Instead, both the samples mainly contain elements such as Zink (Zn), and Copper (Cu) in the ratio of 1:2. This finding indicate that the beads of garlands were made by Brass instead of gold.

5. Conclusion

In this paper an important case study is presented to enlighten the forensic aspects of metal analysis and purity estimation by the utilization of SEM-EDAX instrument. The findings of this case study would help the forensic professionals to analyze and solve the similar cheating cases related to important metals in a great extent.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

All the authors have already been informed regarding this publication, No authors has any objection for this publication.

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