

Quantitative analysis of Gold alloys using NaI (TI) scintillation detectors through neutron activation

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The use of thallium induced sodium iodide detectors in quantitative analysis is not usually done because of its low resolution. However, its relative ease in handling and not being as expensive as other detectors are the reasons for its use. This project aims at devising a procedure to do a quantitative analysis on samples made of gold and copper. The samples were activated by using an Am-Be neutron source. The flux of neutrons and the interaction between neutrons and the target atomic nuclei vary with neutron energy, hence the product of neutron flux density and neutron capture cross section was first found for pure known gold and copper samples. A small part of an earring was tested for its karat value ((mass of gold/total mass)*24) using an XRF spectrometer on multiple points. The XRF readings gave an average karat value of 22.54. After activation, the resulting gamma ray spectrum was analyzed. This gave a karat value of 15. The calculated total mass of the object was only 15% less than the actual mass. It was observed that the object was made by welding together two 22 karat parts by using copper. This excess copper could not be accounted for by using an XRF spectrometer because of structural hindrances. Confirmation tests were done by activating a sample made in the laboratory consisting of a copper sheet wrapped in a gold sheet. The value obtained for the karat value was 21% lower than the actual value, but the mass of the copper sample obtained was only 3% lower than the actual value. The experiment was done by assuming that the objects tested were small enough to be considered to be point objects, and the attenuation of the emitted gamma rays were not considered due to the complex nature of the sample structures. Given the accuracy by which the copper content was measured even with the assumptions, this procedure can be used to identify irregularities in the karat value of objects made using copper and gold alloys with further improvements.