



Research Article

Search for Isotopic Anomalies in Alchemical Silver Coins from the Germanischen National Museum in Nuremberg

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Abstract

We analyzed six silver coins of supposedly alchemical origin. They were manufactured during the 17th and 18th centuries, and kept in the Germanischen National Museum in Nuremberg in Germany. We did both nondestructive chemical and isotopic analysis. Silver has two stable isotopes, and our measurements indicate that the silver of all the coins have natural isotopic composition. We conclude that the silver contained in these coins is not of artificial origin. This does not prove that alchemists did not succeed in transmuting metals, but we have shown that the silver of these six coins is most likely of natural origin.

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1. Introduction

According to science, it is impossible to produce nuclear reactions by chemical means. However, with the discovery of Cold Fusion [1], experimental demonstrations of low-energy nuclear reactions have resulted in transmutation of elements by electrolysis [2]. Moreover, recently Iwamura et al. [3] have shown that transmutation occurs without electrolysis. All these recent results indicate that in the past, alchemists may have found a way to do the same. Recent

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Figure 1. Photograph of both sides of the coins analyzed. Ref 8882, Krohnemann.

isotopic analysis of these transmutations obtained by electrochemical or chemical means indicates that the isotopic ratios of the newly formed elements differ from natural elements, inciting us to perform isotopic analysis of metals allegedly produced by alchemy.

In the last two millennia, numerous people from different continents, civilizations and historic eras, claimed that they were able to transmute base metals such as mercury or lead into noble metals such as gold or silver. During the 17th and 18th centuries in Europe, many adepts of alchemy organized public exhibitions of their art in the presence of their protector and counselors. Even coins and commemorative medals were minted with this allegedly transmuted, a few dozens of which are kept today in several museums throughout the world.

Some of these objects have undergone chemical analysis, confirming that they are actually mostly made of gold or silver, with some other minority or trace elements such as copper, lead, mercury, silicon, etc. But to our knowledge, none of these objects has undergone any nuclear analysis, the only class of analysis providing potential evidence of nuclear reactions such as those claimed by the alchemists.

We measured the isotopic composition of the silver contained in six “alchemical” coins from the collection of the Germanischen National Museums (GNM) in Nuremberg, Germany, with a Time Of Flight Secondary Ion Mass Spectrometer (TOF-SIMS). These isotopic compositions are all normal, i.e. identical to the isotopic composition of natural (terrestrial) silver. These results demonstrate unambiguously that the metals used to mint these six “alchemical” coins come from landmines, and are not the result of alleged alchemical transmutations.

Alchemy is the ancestor of modern chemistry and, as such, is worthy of investigation. Adepts have always stated that they have succeeded in transmuting metals, i.e. in triggering nuclear reactions. With their equipment (athanors,

Table 1. Name and year of production of the coins

GNM No.	Year	Name
Mü 8882	1679	Krohnemann
Med 5941	1679	Krohnemann
Med 6010	1705	Unbekannt
Med 5948	ca 1700	Rosenkreuser
Med 5937	Unknown	Lune
Med 6215	Unknown	Solis



Figure 2. Photograph of both sides of the coins analyzed. Ref : 5941, Krohnemann.

alambics, crucibles, etc.) they were capable of producing chemical reactions, but at the present time are not believed to trigger nuclear reactions because of the huge difference in the energy threshold level: typically 1 eV per atom for a chemical reaction and 1 MeV per atom for a nuclear reaction, i.e. six orders of magnitude higher. That is why transmutations obtained by these adepts are viewed as absolutely impossible by modern scientists.

The isotopic distribution of metals in nature coming from the fact that heavy metals were formed in a dying star. If an element is produced artificially, the isotopic composition is very likely to be different from that of the natural element. As gold has only one stable isotope, we could not look for isotopic anomalies in transmuted gold. However, silver has two stable isotopes and therefore any deviation from the natural composition can be looked for. Standard isotopic compositions are compiled and published by the International Union of Pure and Applied Chemistry [4]. For Silver, the standard isotopic composition is, in at. %: 51.839% for ^{107}Ag and 48.161% for ^{109}Ag . This standard isotopic composition is constant wherever the landmine is located throughout the world, within a range of a few parts per thousand (‰).

2. Silver Isotopic Compositions of the Six “Alchemical” Coins of the Nuremberg Museum

2.1. Description of the Coins

This collection has been carefully studied from a historical point of view [5], and we are sure that they are supposedly been produced by alchemists. We analyzed one coin and five medals (for the sake of simplicity, we will use the generic

Table 2. Chemical analyses of coins

Coin	Ag	Cu	S	Hg	Si
Hercules	100.0	–	–	–	–
Marie Curie	100.0	–	–	–	–
Mü 8882	95.0	5.0	–	–	–
Med 5941	95.0	2.0	3.0	–	–
Med 6010	89.3	1.8	2.5	0.3	6.1
Med 5948	95.5	1.5	0.5	–	2.5
Med 5937	84.6	4.6	8.8	2.0	–
Med 6215	52.0	6.0	26.0	13.5	2.5



Figure 3. Photograph of both sides of the coins analyzed. Ref 6010 : Unbekannt.

term of “coins”). Table 1 gives the museum reference, the year of production and the name of the various coins. Figures 1–6 show photographs of both sides of the six coins that have been studied.

In addition to these six “alchemical” coins, we analyzed two French contemporary silver collection coins (99.99% of Ag) in order to get a benchmark for our measurements:

A 50 Francs coin “Hercules”, minted in 1974,

A 100 Francs coin “Marie Curie”, minted in 1984.

2.2. Chemical Analysis

Surface chemical analyses have been performed by X-rays fluorescence in a JEOL Scanning Electron Microscope (SEM) at the CRM CN Laboratory by Energy Dispersive Spectroscopy (EDS). Precision of measurements being 1.0%.

For each coin, measurements have been done between 2 and 5 times on heads and tails of the coins, at different locations. Here are the results in at.% (Table 2).

These six “alchemical” coins are mostly made of silver. Copper is measured, as it is the case in regular silver coins (Sterling, Thaler, etc.). Sulphur and mercury were expected since these two elements were widely used by alchemists. Silicon is likely attributable to the use of crucibles made of refractory materials.

2.3. Isotopic Composition Measurements

2.3.1. Procedure

Non destructive mass analysis was performed at the Ecole des Mines with a Charles Evans TOF-SIMS. A gallium ion gun sputters surface atoms that are ionized by impact of the incident beam, and then depending on their mass arrive at the detector at different times.

The spectrometer has a mass resolution of 9000 at mass 28 on silicon wafer, but only mass resolutions of 4000 can be obtained on such coins due to roughness of their surfaces. However, this is enough to easily separate metallic ions from hydrocarbons ions having same atomic masses. Sensitivity varies with elements analyzed, and this technique is not good for quantitative analysis. However, for atomic ratios this is a very convenient tool, with a unique advantage of being almost non destructive, since only a few atomic layers are sputtered away during analysis.



Figure 4. Photograph of both sides of the coins analyzed. Ref 5948, Rosenkreuzer.

2.3.2. Results

We first checked our spectrometer by measuring isotopic compositions of natural silver contained in the two regular coins “Hercules” and “Marie Curie”. Within precision of our measurements ($\sigma = 1.0\%$), these two measured isotopic compositions are the standard ones. We then measured isotopic compositions of silver contained in the six “alchemical” coins. Here also, within precision of our measurements, these six measured isotopic compositions are equal to the standard ones. For these “alchemical” coins, we also checked isotopic compositions of other elements contained in the coins, even though there was no reason why their isotopic composition would have not been standard. Copper, mercury, sulfur and silicon all had standard isotopic compositions.

3. Discussion

For these alchemical coins, the isotopic composition of silver is equal to the standard isotopic ratio. If this silver was of alchemical origin, i.e. transmuted from another metal, then the probability that its isotopic composition be equal to the standard one would have been close to zero, not to say zero.



Figure 5. Photograph of both sides of the coins analyzed. Ref : 5937, Luna.



Figure 6. Photograph of both sides of the coins analyzed. Ref 6215 : Solis.

Actually, the probability depends on precision of measurements: 1% in our case. That is why we can state unambiguously that the silver contained in these coins is natural.

However, only six silver “alchemical” coins were analyzed out of a total of 34 silver coins stored in the museums of Nuremberg, Wien, Dresden and Munich [6].

4. Conclusion

We measured the isotopic composition of the silver contained in six “alchemical” coins coming from the collection of the Germanischen National Museums (GNM) in Nuremberg, Germany, with a TOF-SIMS. These isotopic compositions are normal, i.e. identical to the isotopic composition of natural (terrestrial) silver. These results demonstrate unambiguously that metals used for minting these six “alchemical” coins come from landmines, and are not the result of some alleged alchemical transmutations.

With these results of nuclear analysis, the first to our knowledge, we propose a method capable of providing a definitive and irrefutable answer to the question of the allegedly transmutation of a base metal into silver, proclaimed by numerous adepts of alchemy for centuries.

These results are not a definitive proof that alchemy never existed because they are partial: only six silver “alchemical” coins have been analyzed out of a total of at least 34 kept in museums. But it is a serious hint.

To have a definitive answer, since the analysis is totally non-destructive, we invite the aforesaid museums to lend us their silver “alchemical” coins for analysis.

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