

# **Search for isotopic anomalies in alchemical silver coins from the Germanischen National Museum in Nuremberg**

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## **Abstract:**

We have analyzed six silver coins of supposedly alchemical origin. They have been manufactured during the XVII<sup>th</sup> and XVIII<sup>th</sup> centuries, and kept in the Germanischen National Museum in Nuremberg in Germany. We have done 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.

## **1- Introduction**

According to science, it is impossible to do nuclear reaction by chemical means. However with the discovery of Cold Fusion [<sup>1</sup>], experimental demonstrations of low energy nuclear reactions have resulted in transmutation of elements by electrolysis [<sup>2</sup>]. Moreover, recently Iwamura et al [<sup>3</sup>] have shown that transmutation occurs without electrolysis. All these recent results indicate that maybe in the past, alchemists had found a way to do the same. The recent isotopic analysis of these transmutations obtained by electrochemical or chemical ways indicate that the isotopic ratios of the newly formed elements differ from natural ones. Therefore it is tempting to do isotopic analysis of metals allegedly produced by alchemy.

During the last two millennia, numerous people from different continents, civilizations and historic eras, have proclaimed that they were able to transmute base metals, such as mercury or lead, into noble metals, such as gold or silver. During the XVII<sup>th</sup> and XVIII<sup>th</sup> centuries, in Europe, many adepts of alchemy have proceeded to what they claimed “public exhibitions” in the presence of their protector and counselors. Sometimes, coins and “commemorative” medals have been minted with this allegedly “transmuted” metal. That is why a few dozens of these objects are kept today in several museums throughout the world.

A few 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, ... But to our knowledge, no one of these objects has undergone any nuclear analysis, the only class of analysis able to find some potential evidence of nuclear reactions as claimed by the alchemists.

We have 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 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 for minting these six “alchemical” coins come from landmines, and are not the result of some 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. trigger nuclear reactions. With their equipment (athanors, alambics, crucibles, ...), they were capable of producing chemical reactions, but not supposed to trigger nuclear reactions because of the huge difference in the energy threshold level : typically 1 eV/atom for a chemical reaction and 1 MeV/atom for a nuclear reaction, i.e. six orders of magnitude higher. That is why transmutations obtained by those adepts are merely viewed as impossible by modern scientists.

The origin of the isotopic distribution of metals in nature is coming from its origin when it was formed in a dying star. If an element is produced artificially, the isotopic composition is very likely to be different from the natural one. As gold has only one stable isotope, we could not check for isotopic anomalies in transmuted gold. However silver has two stable isotopes and therefore any deviation from the natural composition can be checked. 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 atom % : 51.839 % for Ag-107 and 48.161 % for Ag-109. This standard isotopic composition is invariant wherever the landmine is located throughout the world, within a range of a few thousands (‰).

## **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 have analyzed one coin and five medals (for the sake of simplicity, we will use the generic term of “coins”). Table 1 gives the museum reference, the year of production and the name of the various coins.

GNM n°	Year	Name
Mü 8882	1679	Krohnemann
Med 5941	1679	Krohnemann
Med 6010	1705	Unbekannt
Med 5948	ca 1700	Rosenkreuser
Med 5937	Unknown	Luna
Med 6215	Unknown	Solis

**Table 1:**  
**Name and year of production of the coins**

Figure 1 shows photographs of both sides of the six coins that have been studied.





ref 5948, Rosenkreuser



Ref : 5937, Luna



Ref 6215 : Solis

Figure 1: A photograph of both sides of the coins analyzed

In addition to these 6 “alchemical” coins, we have analyzed two French contemporary silver collection coins (99.99 % of Ag) in order to have 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 done by X-rays fluorescence in a JEOL Scanning Electron Microscope (SEM) at the CRM-CN Laboratory by Energy Dispersive Spectroscopy (EDS). The precision of the measurements is 1.0 %.

For each coin, the measurements have been done between 2 and 5 times on heads and tails of the coins, at different locations.

Here are the results in atom%:

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

**Table n°2 : Chemical analyses of coins**

These six “alchemical” coins are mostly made of silver. Copper is present, as it is in regular silver coins (Sterling, Thaler, ...). 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

The non destructive mass analysis was performed at the Ecole des Mines with a Charles Evans TOF-SIMS (Time of Flight - Secondary Ions Mass Spectrometer). A gallium ion gun sputters the surface atoms that are ionized by the 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 the roughness of their surfaces. However this is enough to easily separate metallic ions from hydrocarbons ions having same atomic masses. Sensitivity varies with the elements, 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.

### 2. 3. 2 – Results

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

### 3 – Discussion

For these alchemical coins, the isotopic composition of silver is the standard one. 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 is close to zero, not to say zero.

Actually, the probability depends on the precision of the measurements: 1/100 for a precision of 1 % in our case. That is why we can state unambiguously that the silver of these coins is natural silver coming from a landmine.

However, only 6 silver “alchemical” coins have been analysed out of a total of 34 ones, at least, conserved in the museums of Nuremberg, Wien, Dresden and Munich [6].

### 4 - Conclusion

We have measured the isotopic composition of the silver of six “alchemical” coins coming 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 normal, i.e. identical to the isotopic composition of natural (terrestrial) silver. These results demonstrate unambiguously that the 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 able to provide a definitive and irrefutable answer to the question of the allegedly transmutation of a base metal into silver, proclaimed by numerous adepts of alchemy throughout the centuries.

These results are not a definitive proof that alchemy never existed because they are partial: only 6 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.

### Acknowledgments

The authors wish to thank Dr Hermann Maué, Germanischen National Museums in Nuremberg, for the loan of the coins and Pr Vladimir Karpenko, University of Prag, for fruitful discussions.

**References:**

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