


実験報告書様式(一般利用課題・成果公開利用)

(※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。)

 MLF Experimental Report	提出日 Date of Report Jul. 26, 2011
課題番号 Project No. 2010B0031 実験課題名 Title of experiment Development of non-destructive multi-elemental analysis system by muonic X-ray 実験責任者名 Name of principal investigator Kenya Kubo 所属 Affiliation International Christian University	装置責任者 Name of responsible person Yasuhiro Miyake 装置名 Name of Instrument/(BL No.) D2 実施日 Date of Experiment Jan. 28, 2011 – Feb. 01, 2011

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)
 Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.
Kapton film Gold-Silver alloy Tempo-Tsuho (old Japanese bronze coin)

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。) Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.
<p>In order to certify the elemental composition measurement results of 2010A0051 for a Tempo koban (an old Japanese gold coin) we measured muonic X-rays from standard gold-silver alloy at the MUSE D2 port. We also tried to analyze the elemental compositions of two different mint Tempo-Tsuho coins, old Japanese bronze coins.</p> <p>The samples were set in a vacuum chamber used for the previous experiment (2010B0080) and three Ge detectors were used.</p> <p>Two Au-Ag alloy samples with Au content of 80% and 60% were analyzed in order to check the negative muon capture probability ratio of Au and Ag. The summarizing Figure 1 shows that the Au/Ag capture ratio was 1.97 ± 0.09 slightly higher than the value predicted by the Fermi-Teller Z law. By using this experimental value the elemental composition of the Tempo koban was determined as 72% and 57% at the sub-surface and the interior, respectively.</p> <p>Two Tempo-Tsuho coins showed very similar elemental compositions containing copper, tin and lead. By comparing with the measurement data for modern bronze of known composition, we are now estimating the</p>

2. 実験方法及び結果(つづき) Experimental method and results (continued)

From μ Ag 4-3 and μ Au 5-4 Intensities

Au 80% Ag 20%:

(muon capture in Au) / (muon capture in Ag) = 1.63 ± 0.03

$A(\text{Au/Ag}) = 1.99 \pm 0.11$

Au 60% Ag 40%:

(muon capture in Au) / (muon capture in Ag) = 4.27 ± 0.33

$A(\text{Au/Ag}) = 1.95 \pm 0.15$

$A(\text{Au/Ag}) = 1.97 \pm 0.09$

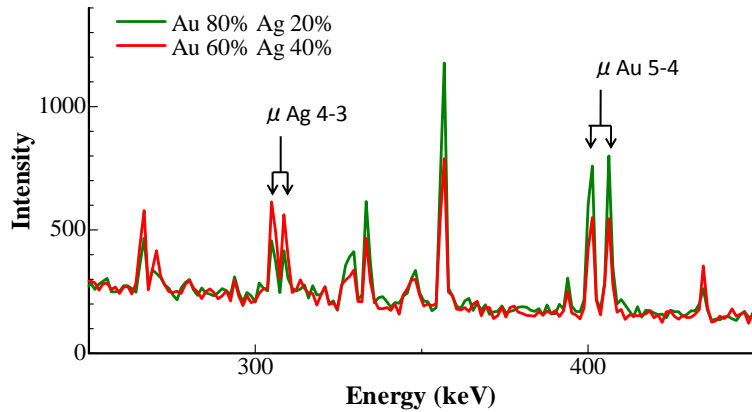


Figure 1. Muonic X-ray spectra of Au-Ag alloy samples.

we may conclude that the mint technique at the late Edo era was established and produced coins of uniform quality.