

An Attempt to Change the Half-Lives of β -Decay Nuclides

*Hiroshi Baba(0003704), Naruto Takahashi(0003701),
Akihiko Yokoyama(0003940), Koichi Takamiya(0003708),
Hirokazu Araki(0003709), Jun Sanada(0003710),
Atsushi Toyoshima(0004173), Junichi Morinaga(0004174) and
Atsushi Shinohara¹(0004054)

Department of Chemistry, Graduate School of Science, Osaka University

¹Research Reactor Institute, Kyoto University

According to Fermi's β -decay theory, the life time of a β -decay nuclide is inversely proportional to the electron density at the position of the nucleus. It was attempted to change the half-lives of β -decay nuclides by stripping orbital electrons by means of X-ray irradiation at the BL08W line of SPring-8. β -decay nuclides were prepared by neutron irradiation using Kyoto University reactor KUR. Ruthenium-105 and ¹⁴⁰La were chosen as activities to be studied. Ruthenium metal powder and La₂O₃ irradiated in the pneumatic tube of KUR were sealed in a polyethylene sheet, to form about 5mm ϕ dia. disk, which were further sealed between two 1mm thick Al disks of 25mm ϕ dia. by pressing. The prepared sources were transported to Sprin-8 to irradiate with X-rays.

Two irradiation experiments were carried out. The first experiment was carried out at 300 keV BL08W beam line for 2 shifts, 16 hours. Radioactive decay of ¹⁰⁵Ru was traced for 5 hours with a Ge detector while the source was irradiated by X rays. Signals from the Ge detector were fed to a multi-channel pulse height analyzer to construct the ¹⁰⁵Ru γ -ray spectrum which was analyzed using a γ -ray spectrum analyzing program BOB76.

Time sequences of photopeak intensities of 6 main γ -rays of ¹⁰⁵Ru are shown in Fig. 1 with the associated errors of 99.7% confidence level (3σ). The deduced half-life values of 6 γ -rays converged in a reasonable range considering the involved errors of the least squares fit. The weighted mean of the six half-life data was

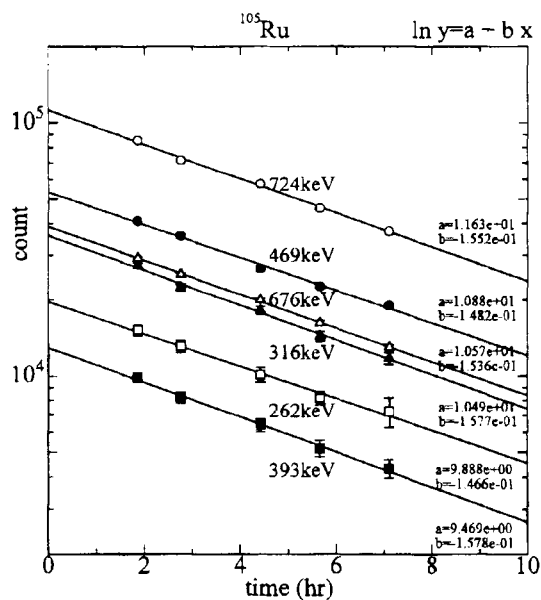


Fig.1. Decay curves of 6 main γ rays of ¹⁰⁵Ru.

4.42 ± 0.11 h, which is suggesting the possibility that the half-life of ¹⁰⁵Ru has been reduced by 0.5% by means of X-ray irradiation, though there is a reservation for the conclusion because of the substantial error involved.

A similar irradiation experiment was carried out with ¹⁴⁰La for 8 hours. However, any positive result was not observed this time. This is probably because the running duration was too short compared to the half-life of ¹⁴⁰La and the X-ray intensity was not strong enough.

In the second experiment, at 100 keV BL08W beam line, ¹⁴⁰La was irradiated with X-rays 100 times strongest than the first experiment. The analysis of the data is still under way. Preliminary results are, however, quite promising.