Study on the lattice damage effect in high-resolution alpha spectrometers using metallic magnetic calorimeters

Main author:

KIM So-Ra

Co-authors:

choi Junho, Institute for Basic Science, Republic of Korea
Jo Hyon-Suk, Institute for Basic Science, Republic of Korea
Kang Chan Seok, Institute for Basic Science, Republic of Korea
Kim Yong-Hamb, Institute for Basic Science, Republic of Korea
Kim Inwook, Institute for Basic Science, Republic of Korea
Kim Hyelim, Institute for Basic Science, Republic of Korea
Kim Geon-Bo, Institute for Basic Science, Republic of Korea
KIM So-Ra, Institute for Basic science
Lee Minkyu, Korea Research Institute of Standards and Science, Republic of Korea
Lee Juhee, Institute for Basic Science, Republic of Korea
Lee Hyejin, Institute for Basic Science, Republic of Korea
Oh Seung-Yoon, Institute for Basic Science, Republic of Korea
Sala Elena, Institute for Basic Science, Republic of Korea
So Jungho, Institute for Basic Science, Republic of Korea
Yoon Wonsik, Institute for Basic Science, Republic of Korea

There has been a claim that lattice damage in alpha spectroscopy is an intrinsic source of resolution degradation. Lattice damage is the unobservable energy stored in the Frenkel defect composed of interstitial atom and vacancy pairs in a solid-state absorber. We made high-resolution alpha spectrometers based on a metallic magnetic calorimeter with various metal absorbers. A series of measurements were made with an 241Am source on a gold foil absorber at different temperatures in the 40-100 mK range. The measurement resolution of alpha particles was compared with the baseline resolution and 60-keV gamma resolution in different experimental conditions. A series of analyses suggests that a resolution degrading term of 0.9 keV FWHM exists in alpha measurement with a gold absorber regardless of the temperature. We discuss how this limit is attributed to the lattice damage effect and try to quantize the term with Frenkel

pair energy and displacement energy in the gold absorber. Moreover, these results will be compared with new experiments obtained with the same setup but replacing the gold absorber with silver and copper pieces of the same dimensions.