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

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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.