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Alpha particle spectrometry using superconducting microcalorimeters ROBERT HORANSKY, JOEL ULLOM, JAMES BEALL, GENE HILTON, GREGORY STIEHL, KENT IRWIN, NIST, ALEXANDER PLIONIS, STEPHEN LAMONT, CLIFFORD RUDY, MICHAEL RABIN, LANL — Alpha spectrometry is the preferred technique for analyzing trace samples of radioactive material because the alpha particle flux can be significantly higher than the gamma-ray flux from nuclear materials of interest. Traditionally, alpha spectrometry is performed with Si detectors whose resolution is at best 8 keV FWHM. Here, we describe the design and operation of a microcalorimeter alpha detector with an energy resolution of 1.06 keV FWHM at 5 MeV. We demonstrate the ability of the microcalorimeter to clearly resolve the alpha particles from Pu-239 and Pu-240, whose ratio differentiates reactor-grade Pu from weapons-grade. We also show the first direct observation of the decay of Po-209 to the ground state of Pb-205 which has traditionally been obscured by a much stronger alpha line 2 keV away. Finally, the 1.06 keV resolution observed for alpha particles is far worse than the 0.12 keV resolution predicted from thermal fluctuations and measurement of gamma-rays. The cause of the resolution degradation may be ion damage in the tin. Hence, alpha particle microcalorimeters may provide a novel tool for studying ion damage and lattice displacement energies in bulk materials.

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