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High Resolution Gamma-Ray Spectroscopy with Superconducting Microcalorimeters D.A. BENNETT, NIST, J.N. ULLOM, W.B. DORIESE, J.A. BEALL, G.C. HILTON, R.D. HORANSKY, K.D. IRWIN, N. JETHAVA, E. SASSI, L.R. VALE, NIST, M.K. BACRANIA, A.S. HOOVER, N. HOTELING, P.J. KARPIUS, M.W. RABIN, C.R. RUDY, D.T. VO, Los Alamos National Laboratory
— We are currently developing high resolution gamma-ray microcalorimeters (uCal) for improved analysis of nuclear materials. The uCal consist of a bulk superconducting absorber attached to a transition-edge sensor (TES) biased in its resistive transition and operated at temperatures near 0.1 K. Incoming particles and photons are converted to heat in the absorber and the resulting temperature change is measured by the highly sensitive TES thermometer. The unmatched energy resolution of these devices is useful for nuclear safeguards. A specific application is the determination of Pu isotopics in complex mixtures. Although much of our effort is focused on the construction and multiplexed readout of large arrays of detectors for increased collection area, we are also working on optimizing the performance of individual pixels. To this end, we have developed an analytic uCal model that includes the thermal properties of the attached absorber and the large inductance in the TES circuit bias. We show how this model can be used to maximize the number of sensors that can be multiplexed into a single readout channel and to minimize the response time of individual sensors.

Douglas Bennett
National Institute of Standards and Technology

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