J. Nucl. Med. 31, p. 749 (1990)

ADVANTAGES OF LEAD CARBONATE, A NEW SCINTILLATOR, FOR HIGH-RATE HIGH-RESOLUTION PET IMAGING.

S.E. Derenzo, W.W. Moses and T.F. Budinger. Research Medicine and Radiation Biophysics Division, Lawrence Berkeley Laboratory, University of California, Berkeley, CA.

Lead carbonate, a newly discovered scintillator that is not affected by air or moisture, has a density of 6.6 gm/cm^3 and a stopping power for 511 keV annihilation photons comparable to that of bismuth germanate (BGO). At room temperature, its fluorescence decay lifetime is predominantly (69%) an exponential with a 5.6 ns decay time, and has smaller contributions with 27 ns (28%) and 155 ns (3%) decay times. The total light output is about 10% that of BGO and the emission wavelength is 475 nm. The light output increases greatly on cooling due to an increase in a slow (>1 μs) component, and at –70°C lead carbonate has twice the output of room temperature BGO. The 5.6 ns component is not affected by reduced temperature.

We anticipate that lead carbonate will be useful in high resolution (<2.5 mm fwhm) tomograph designs where each crystal is individually coupled to a photodetector. At room temperature, using two imperfect crystals of a mineral form of lead carbonate, known as cerussite, the measured coincident timing resolution was 1.2 ns fwhm, about 3 times less than BGO. The deadtime was 50 nsec, about 20 times less than BGO.

For tomograph designs using silicon photodiodes to identify the crystal of interaction and the depth of interaction in the crystal, reduced temperatures improve the signal-to-noise ratio greatly by increasing the light output of the crystal and reducing the noise due to dark current in the photodiode.

When quality synthetic crystals become available, the light output and speed of lead carbonate may permit the development of high spatial resolution time-of-flight positron tomography.

J. Nucl. Med. 31, p. 749 (1990)