Abstract

FAST NEUTRON ACTIVATION DOSIMETRY WITH TLDS

By

David W. Pearson

Under the supervision of Professor P. R. Moran

Fast neutron activation using threshold reactions is the only neutron dosimetry method which offers complete discrimination against gamma-rays and preserves some information about the neutron energy. Conventional activation foil technique requires sensitive radiation detectors to count the decay of the neutron induced activity. For extensive measurements at low neutron fluences vast outlays of counting equipment are required. TL dosimeters are inexpensive, extremely sensitive radiation detectors. The work of Mayhugh et. al. (Proc. Third Int. Conf. on Luminescence Dosimetry, Risø Report 249, 1040, (1971)) showed that $CaSO_4$:Dy TLDs could be used to measure the integrated dose from the decay of the radioactivity produced in the dosimeters by exposure to thermal neutrons. This neatly combines the activation detector and counter functions in one solid state device. This work has been expanded to fast neutron exposures and other TL phosphors. The reactions $^{19}F(n,2n)^{18}F$, $^{32}S(n,p)^{32}P$, $^{24}Mg(n,p)^{24}Na$, and $^{64}Zn(n,p)^{64}Cu$ were found to be useful for fast neutron activation in commercial TLDs. As each TLD is its own integrating decay particle counter, many activation measurements can be made at the same time. The subsequent readings of the TL signals can be done serially after the induced radioactivity has decayed using only one TL reader. The neutron

detection sensitivity is limited mainly by the number statistics of the neutron activations. The precision of the neutron measurement is within a factor of two of conventional foil activation for comparable mass detectors. Commercially available TLDs can measure neutron fluences of $10^9 n/cm^2$ with 10% precision.

P K Moran
Prof. Physics and Radiology