Diamond Detectors Ltd

Diamond

Thermal Neutron Detection

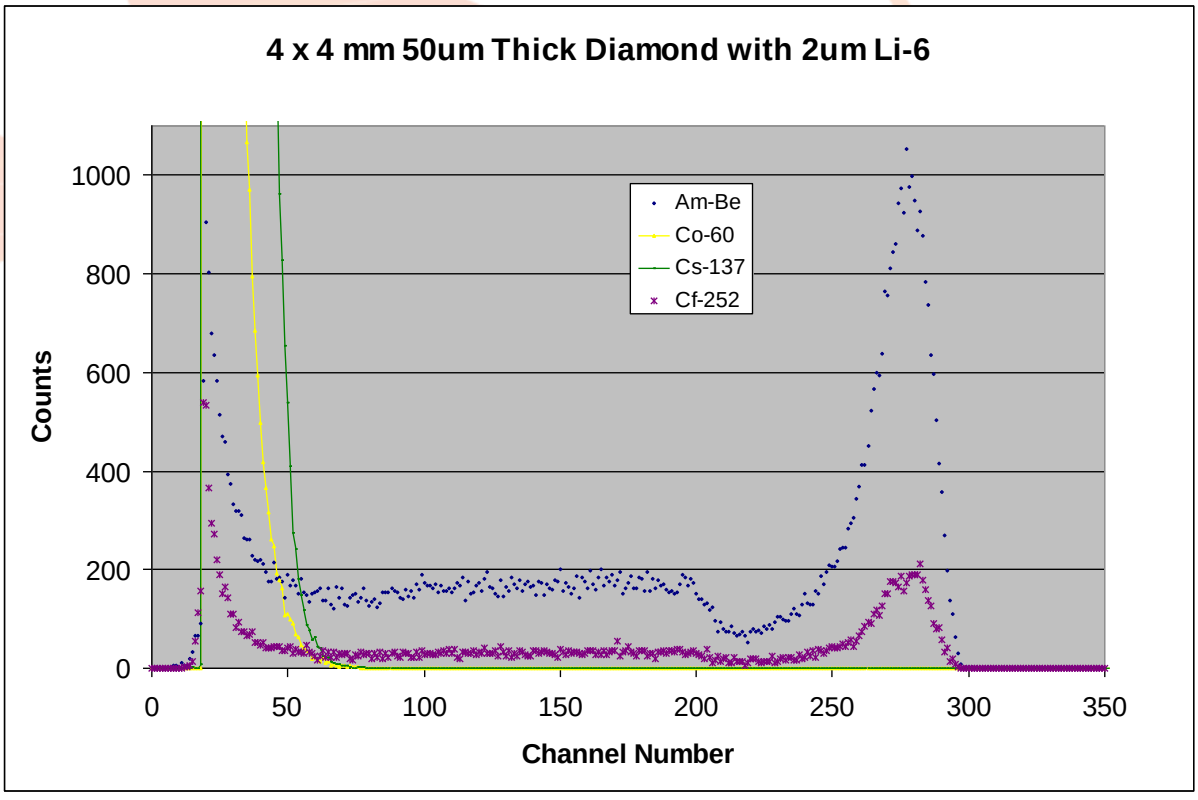
DIAMOND DETECTORS LIMITED

Introduction

Diamond has been identified as an alternative detector technology for the detection of thermal and fast neutrons. Diamond coated with ^{6}LiF can be used for the detection of 2MeV alpha particles from the (n $\rightarrow \alpha$) reaction. Alternative conversion layers include ^{10}B or plastic for proton recoil detection.

Thermal Neutron Results

The plot below illustrates the detector response to various sources. It can be clearly seen that both the ^{137}Cs and ^{60}Co gamma sources only deposit energy up to channel 81, approximately 600keV, while both the neutron sources produce a peak at channel 280 from the (n $\rightarrow \alpha$) reaction. The alpha peak indicates there is little or no response due to direct neutron interaction



Taking a threshold at channel 100, sensitivity values have been determined as 0.00097cps/μSvh^{-1} and 0.00123cps/μSvh^{-1} for Am-Be and ^{252}Cf respectively for a 1mm^{3} detector volume.

Results kindly provided by BAE-Systems Submarines Instrumentation & Calibration Services Department

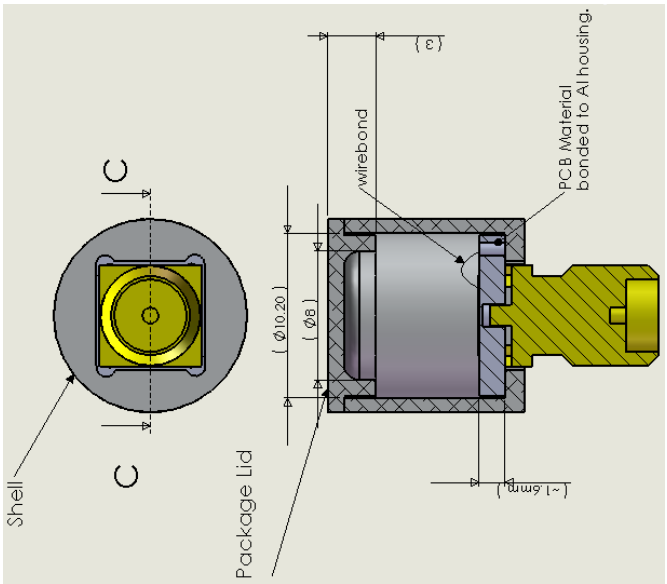
Diamond Detectors Ltd

50 micron Diamond device sensitivity using a single layer 2µ thickness converter of ^{6}LiF			
Source	*Dose Rate*	*Orientation*[1]	*Sensitivity per/mm*^{3}
Am-Be	786	0°	0.00097
Am-Be	786	90°	0.00099
^{252}Cf	88.7	0°	0.00123

In comparison of a 4.5x4.5x0.05mm HPSC cvd diamond device (single ^{6}LiF layer, ~ active volume 1mm^{3}) and a SP9 ^{3}He tube (~ active volume 17160mm^{3}) diamond is 1500 less sensitive. However in comparison by volume the cvd diamond detector is c. 11 x more sensitive.

This 50µm thick device restricts the amount of energy that can be deposited by gamma radiation and direct neutron interaction within the device. A threshold can be set at such a level that most of alpha interactions may be counted whilst providing good gamma rejection.
Although such a diamond device wouldn't be an appropriate choice where significant area/volume would be required (i.e. applications using He-3) its sensitivity, resilience and small footprint makes this an excellent thermal neutron detector.

Package Layout



Results kindly provided by BAE-Systems Submarines Instrumentation & Calibration Services Department