

Amorphous Silicon Strip Detector for ~MeV X-ray imaging

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I. INTRODUCTION

Compared with crystal crystalline silicon, amorphous silicon (a-Si) can be made thinner, which may produce savings on silicon material cost, and a-Si can also be deposited over large areas by PECVD. These advantages attract scientists' focus. We have got several prototypes of a-Si strip detectors from the Fujitsu Company, and we are planning to stack tens of strip detectors to realize 2-D imaging of ~5MeV X-ray with Compton scattering and electron-positron pair production method. Until now, the I-V & C-V characteristics of some detectors have been tested, an FWHM of ~7 keV of the 60 keV γ ray from the Am-241 source was obtained. We also carried out some basic simulations of the stacked silicon strip detector system.

II. TESTS AND SIMULATIONS

The a-Si strip detectors has a Si wafer of 500 μm , a-Si of 11 μm , and aluminum electrodes of 11 μm at the top and bottom side of the detector. Each detector has 50 channels with 0.5 mm width and 0.5 mm pitch between two channels, an total area of 49.5mm $\times$ 49.5mm.

A. I-V& C-V characteristics tests

The I-V& C-V characteristics of a detector were tested and shown in Fig.1.

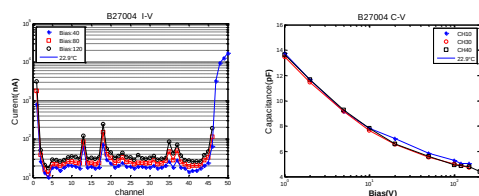


Fig.1 I-V& C-V characteristics

The leakage current of most channels is between 20~40 nA at 120 V bias and 22.9 $^{\circ}\text{C}$. The Fujitsu Company is still trying to optimize the leakage current homogeneity of the strip detector. By the meantime, the

capacitance of different channels are quite the same which means that the thickness of the depletion layers are quite homogeneous.

B. Spectrum measurements

We used the detector to measure the Am-241 and Cs-137 spectra, and the spectra measured with various applied bias voltage with the 8th channel of the B27004 detector are shown in Fig.2. The Am-241 60 keV peak has an FWHM of ~6.5 keV.

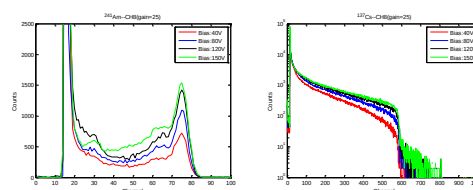


Fig.2 Measured Am-241 and Cs-137 spectra

C. Simulation

A detector system stacked with 4 layers of a-Si strip detectors irradiated with a 662 keV point source was simulated by using the MCNP5 code. The results are shown in Fig.3. From the figure, we can estimate that the source would be at (3, 4) of the x-y plane.

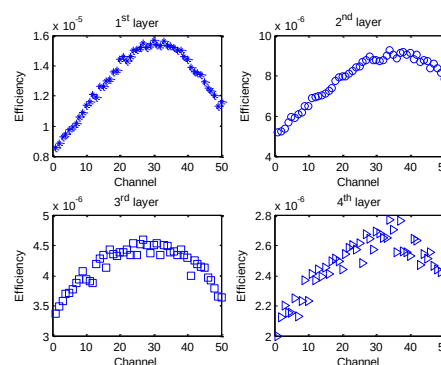


Fig.3 Simulation of the efficiency distribution of 4 layers stacked system

II. FUTURE PLAN

We have tested the a-Si strip detector, and we are now planning to combine stacked strip detectors with ASICs to realize 2D imaging of ~5 MeV X ray.