

Sensors

TRIUMF

omaly Detection (LAD)

se covariance is replaced with the

counts for both spectral and spatial weights

to connect the nearest neighboring pixels

is $\delta(x) = (x - \hat{\mu})^T L(x - \hat{\mu})$

Reflections and dust

ity of large-scale structures

Segmentation

age Segmentation with Pruning

ent

ng those with mean RGB vectors within

repeat until no more merging can occur

re are merged with most similar segment

is defined as background

- Similar errors to LAD
- Slightly more false positives

via Convolutional Neural Network (U-Net)

and outlier detection methods struggle with

terns

Networks have shown success with such

in the past, and U-Net requires little data

Images and linking convolutional and up-

lows retention of more high-res information

Moving Forward

using defect detection Algorithms, but simple methods

and complex patterns

performance and is hard to reproduce

but requires more time. More results in future work.

Feasibility Study on Neutron Dosimetry under Extreme Radiation Environments Using a Diamond Detector

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Motivation

- Since the application of neutron technology in a broad field, the neutrons dose are required to be monitored efficiently. Especially, some harsh environments including Fukushima Daiichi nuclear power plant and high-intensity accelerators such as SuperKEKB produce mixed radiation field.
- There is an urgent need to design a neutron detector that is resistant to high-intensity radiation and can reject high levels of background rays.

Advantage: low leakage current, low capacitance, high electron-hole mobility, radiation resistance, excellent timing resolution

Drawback: low Charge collection efficiency (CCE), low energy resolution

Comparison of Diamond and Silicon Characteristics

Properties	Silicon	Diamond	Benefit of Diamond
Breakdown Field (MV/cm)	2.22	3.47	Low Leakage Current
Detector Center (mm/cm)	42	~20	High Field Operation
Element Mobility (cm ² /Vs)	1350	2700-3000	Carrier Charge Collection
Heat Conductivity (W/mK)	400	2100-4000	Heat Dissipation
Thermal Conductivity (W/mK)	1.5	21	Heat Dissipation

The diamond detector is an ideal choice for measuring neutron flux and dose in comparison to silicon detector.

Simulation

PHITS (Particle and Heavy Ion Transport code System)

What it can do:

Transport and collision of nearly all particles over wide energy range

neutron, proton, meson, baryon, electron, photon, heavy ions

10⁻⁴ eV to 1 TeV

The simulated deposition energies on diamond detectors with different thicknesses for ¹⁰C gamma-rays.

- The sensitivity and deposit energy decreased with decreasing the detector thickness.
- The pile-up events will be less impact.
- The maximum deposition energies were significantly lower than the expected deposition energies from the neutron-induced ¹⁰C for neutron: Pro=2.27 MeV, Ene=2.05 MeV.

Experimental Setup and Result

Diamond Detector:

- Material: sCVD diamond
- Size: 4.5 mm x 4.5 mm
- Thickness: 140 μm
- Thermal-oxide converter
- η_{eff} (85% enrichment)
- Active area: 10 mm²

Experimental Setup:

Neutron Source: ²⁵²Cf

Readout Electronics: Charge Amplifier, ADC, DAQ

Channel Pulse length distribution of Diamond

CCE of the sCVD diamond detector

TCF pulse for charge amplifier in Diamond

Energy: ²⁵²Cf, Energy: ~460 keV

Conclusion

- The deposition energies on diamond detector with different thicknesses for ¹⁰C gamma-rays were simulated.
- We did performance tests in the diamond detector.

The results of the simulation and experiment are used to demonstrate the feasibility of using diamond detector for neutron dosimetry in extreme radiation environments.

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I ♥ HUST

A woman in a blue and white striped dress is speaking and gesturing towards the poster. She is wearing glasses and has a lanyard around her neck. A man in a white t-shirt with 'I ♥ HUST' on it is standing behind her. Other people are visible in the background, some looking at the poster.

A person's hand is visible in the foreground, holding a yellow notepad and a pen, appearing to take notes. The person is wearing a black watch on their wrist.