Characterization of Scintillating Crystal for High Energy Radiation Detection and Applications

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Introduction

Cesium Hafnium Chloride (Cs2HfI6) is a promising metal halide scintillating detector due to its excellent characteristics such as non-hygroscopicity, high light yield without doping. Scintillators plays an important role in nuclear security applications as detectors at border monitoring stations.

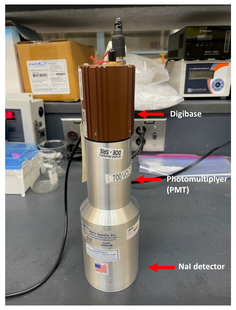
We grew and characterized CHC crystals to be fabricated for gamma detection. Photoluminescence was performed using the Duetta Fluorescence and Absorbance Spectrometer. The energy response to Cs-137 and Co-60 reference sources was recorded for a representative sodium iodide (NaI) scintillating detector.

Methods

Duetta

The Duetta provides information on the optical properties of materials such as absorbance and fluorescence.

Using a Bismuth Telluride (BnTe) pellets we measured emission and excitation spectra to illustrate a typical optical characterization.

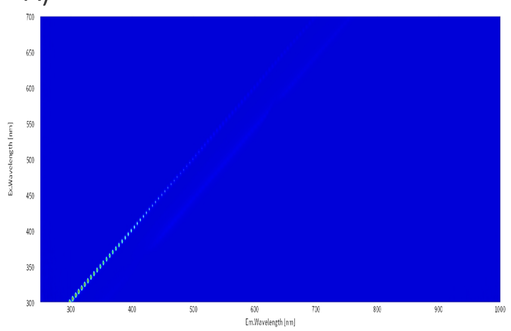


A NaI Scintillating detector which consist of a Digibase, photomultiplier tube (PMT) and NaI crystal detector.

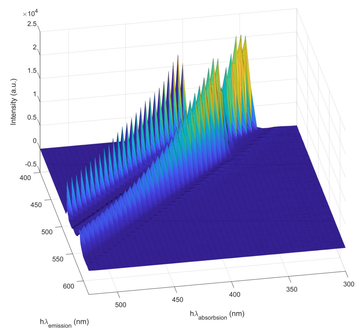
BnTe pellet
3.5 *mm* thickness

Results

A)

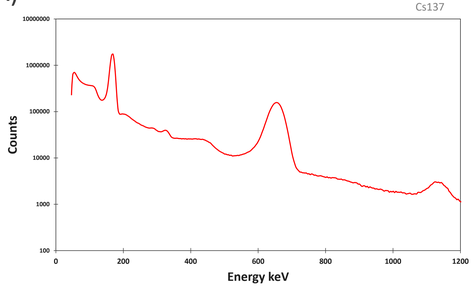


B)

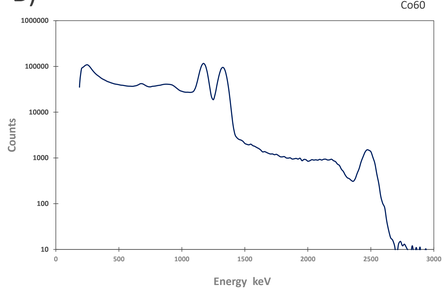


Above: A) UV-VIS emission measured a double band wavelength measured from the BnTe B) is the double band (pictured to the left) expanded to get a clearer view of the intensity of the wavelengths

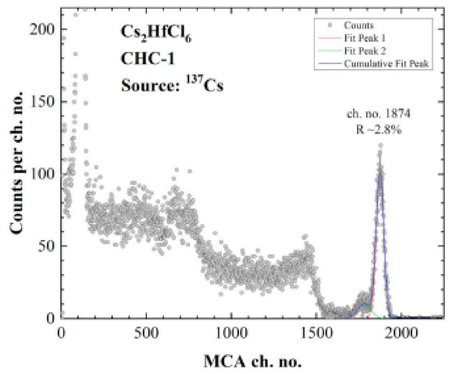
A)



B)



C)



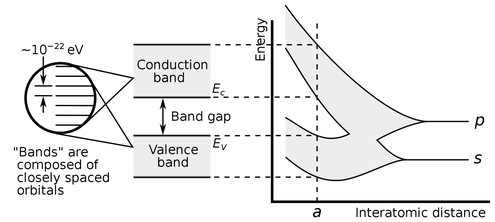
Above image is taken from reference 1

Above A) NaI scintillator detector response to Cs-137 B) Co-60 detector response C) is the response that we are striving to achieve .

Equations

$$hv\,(eV) = \frac{hc}{\lambda} = \frac{1239.8\ (eV*nm)}{\lambda(nm)}$$

Bandgap eV to nm conversion



Above image is taken from reference 2

Discussion

Scintillators require crystal with high purity levels. The characterization methods used gave the understanding of the possibilities of how to recognize the difference in the energies of crystals and how to they change depending on the molecular structure.

1. E. Ariesanti, R. Hawrami, A. Burger, S. Motakef, Improved growth and scintillation properties of intrinsic, non-hygroscopic scintillator Cs_2HfCl_6, *Journal of Luminescence*, Volume 217, 2020
2. By Chetvorno - Own work, CC0, https://commons.wikimedia.org/w/index.php?curid=56983339

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