

Radiation Response of an In-House Synthesized and Grown Stilbene Seed Crystal

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Organic scintillators such as stilbene are widely used for radiation detection applications requiring fast timing and neutron–gamma discrimination. Following the recent discontinuation of commercial stilbene detectors, the development of in-house synthesis and crystal growth techniques has become increasingly important. In this work, the synthesis, purification, seed growth, and gamma-ray response of an in-house grown stilbene seed crystal were investigated as a foundational step toward stilbene detector development.

Stilbene was synthesized via a solution based reaction route and recovered as a polycrystalline powder. Successful synthesis was confirmed by Fourier transform infrared (FT-IR) spectroscopy through characteristic vibrational peaks of trans stilbene. The synthesized powder was further purified by repeated recrystallization, and nuclear magnetic resonance (NMR) analysis confirmed a progressive reduction of impurity related signals, indicating improved stilbene purity prior to crystal growth.

Seed crystals were prepared using a controlled solution growth process based on slow solvent evaporation under stabilized thermal conditions. Recrystallized stilbene powder was dissolved in toluene, and millimeter scale single crystal seeds were obtained by suppressing rapid nucleation and promoting preferential growth on selected nuclei. The resulting seed crystals were optically transparent and mechanically stable, enabling preliminary radiation response measurements.

For gamma-ray characterization, the stilbene seed crystal was optically coupled to a photomultiplier tube and measured using a ¹³⁷Cs gamma-ray source. The gamma energy spectrum exhibited a Compton dominated response characteristic of organic scintillators, with a clearly pronounced Compton edge corresponding to 662 keV gamma rays.

Based on these results, further growth of the stilbene seed crystal toward the centimeter scale is planned using a crystallizer system. Following bulk crystal growth, neutron irradiation experiments will be conducted to evaluate neutron/gamma discrimination performance using pulse shape discrimination techniques.

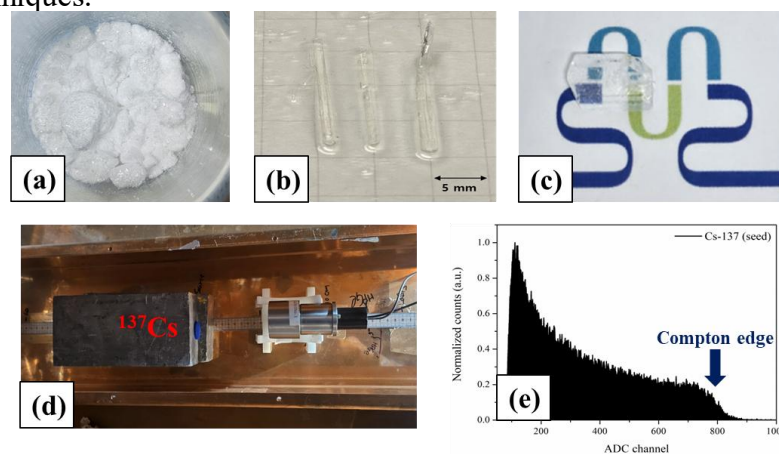


Fig. 1. (a) Synthesized stilbene powder. (b) Stilbene seeds. (c) Representative dimensions of the seed crystal ($7 \times 13 \times 2 \text{ mm}^3$). (d) Experimental setup for Cs-137 gamma-ray measurement. (e) Normalized energy spectrum measured with the stilbene seed crystal.

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