

Fabrication of Novel Deuterated Plastic Scintillators for Neutron Spectroscopy

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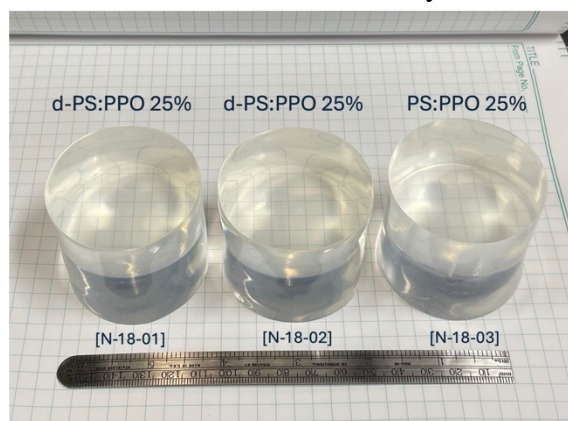
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Deuterated (²H-based) scintillators provide advantages over their hydrogenous (¹H-based) counterparts for measuring neutron energy spectra [1,2]. However, previous studies have been limited to deuterated organic crystal [3] or liquid scintillators [4], which tend to be difficult and costly to produce (crystals) or toxic and flammable (liquids). The absence of commercially available deuterated pulse shape discriminating (PSD) plastics presents an opportunity for development of such an alternative, which could enable the design of a more robust and sophisticated portable neutron spectrometer than currently exists.

In this work, novel deuterated (based on styrene-d₈) polystyrene scintillators up to Ø2" x 2" are fabricated (*pictured right*) and evaluated for use in a compact handheld fast-neutron spectrometer. Non-deuterated samples (based on natural styrene) of equal sizes are produced under identical conditions to serve as references. Characterization of the light output, pulse shape discrimination capabilities, detector response matrix, and ability to distinguish between fission and non-fission neutron sources is presented. Strategies for improving the synthesis methods – in particular, purification of styrene-d₈ raw material – are also explored, and the effects on optical quality and detector performance are evaluated.



Custom-made 2" x 2" PSD-capable deuterated polystyrene (d-PS) and natural polystyrene (PS) plastic scintillators.

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