Polysiloxane Scintillators for Pulse Shape Discrimination and their Temperature Dependence

Caleb Chandler and Jonathan Arrue

Advisors: Alan Sellinger, Anna Erickson

Colorado School of Mines, Georgia Institute of Technology

chandler@mines.edu, jarrue3@gatech.edu

Abstract:

Polysiloxane scintillators have demonstrated efficient pulse shape discrimination and high light outputs at dopant loadings lower than traditional polyvinyltoluene scintillators. Several different polysiloxane matrix materials were tested for their light output, PSD abilities, and temperature dependence when loaded with varying amounts of 2,5 diphenyl oxazole (PPO), 9,9-dimethyl-2-phenylfluorene (PhF), and 9,9-dimethyl-2,7-distrylfluorene (SFS). Regardless of the primary dopant, at around 5%, some polysiloxanes were able to outperform commercial plastic scintillator EJ-299 in PSD ability. This loading corresponds to approximately $1/5^{th}$ of the dopant required for PSD in vinyltoluene. The light output was nearly the same or higher than EJ-299 and the PSD abilities increased by around 10% at around 50 °C when compared to PSD ability at room temperature. This is unique to the polysiloxane scintillators as this was not observed in similarly doped PVT based scintillators. The light output of each of the PVT samples decreased over the same temperature range. This change was small, only around 5% when compared to room temperature. All matrices tested are curable in 3 hours, or are modified to be cured in 3 hrs, at 150 °C in air. Polysiloxane scintillators exhibit an increase in detection performance with temperature, contrary to traditional polyvinyltoluene plastics. Some polysiloxane matrix materials are identified as having especially promising PSD properties or dopant solubility.