

Plastic Scintillator for Muon Radiography

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It is reported that cosmic-ray muon radiography can provide clear images of the internal structure of volcanoes [1-2]. With real time readings, the method may help in predicting eruptions. A double-layer detector consisting cross-aligned plastic scintillator arrays (a segmented detector) can be used for determining the muon path through the volcano. Recently, CI-CR plastic scintillator was developed for the purpose of cosmic-ray muon radiography of a volcano. Among various types of plastic scintillators, our scintillator has some advantages as follows:

- (1) Price is lower.
- (2) Thus, it can cover large area.

We surveyed the detection efficiency of the plastic scintillator as a function of the distance from a 2-inch photomultiplier tube and found that the efficiency was almost uniform in a 1-m² segmented detector. No strong light attenuation was found. Some features of our plastic scintillators are summarized in Table 1.

Table 1. Features of CI-CR plastic scintillator

A Composition of CI-CR Plastic-scintillator		
1) Base resin (PS) Polystyrene	[C_8H_8]	100% (per weight)
2) para-Terphenyl (1,4 diphenyl benzene)	[C_18H_14]	1% (per weight)
3) POPOP (1,4-Bis[2-5-phenyloxazolyl])-benzene	[C_24H_16N_2O_2]	0.03% (per weight)
B Specific Density		1.04 (g/cm ³)
C Peak Wavelength		420 nm
D Decay Constant		3.0~3.2 ns
E Scintillation Efficiency (% Anthracene)		60~50 %
F Light Attenuation Length		110~90 cm
G Refractive Index		1.5
H Softing Point		80~82 °C

References

- [1] Tanaka, H. K. M., Nakano, T., Takahashi, S., Yoshida, J., Takeo, M., Oikawa, J., Ohminato, T., Aoki, Y., Koyama, E., Tsuji, H., Niwa, K. High resolution imaging in the inhomogeneous crust with cosmic-ray muon radiography: The density structure below the volcanic crater floor of Mt. Asama, Japan, *Earth Planet. Sci. Lett.*, 263, 104-113 (2007).
- [2] Tanaka, H. K. M., Nakano, T., Takahashi, S., Yoshida, J., Ohshima, H., Maekawa, T., Watanabe, H., Niwa, K. Imaging the conduit size of the dome with cosmic-ray muons: The structure beneath Showa-Shinzan lava dome, Japan, *Geophys. Res. Lett.*, 34, L22311 (2007).