


Influence of Chemically Etched Reflective Layer Thickness of Scintillator Strips on Light Collection

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Introduction

The formation of a reflective surface, which enhances light collection and improves the stability of the light signal, is important. One of the alternative coating methods is chemical etching, which allows for the formation of a micro-structured reflective layer directly on the scintillator surface, with its thickness determined by the exposure time.
Studying the dependence between **etching time** and **optical parameters**, such as **light collection** , **transparency**, and **reflection coefficient**, is a relevant task.

Structure of the reflective layer obtained by chemical etching

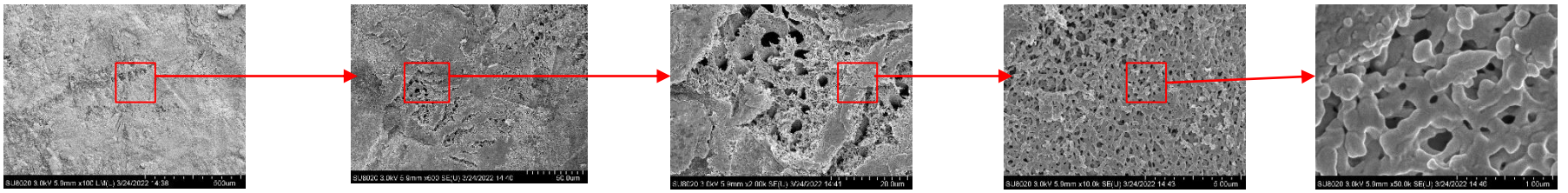
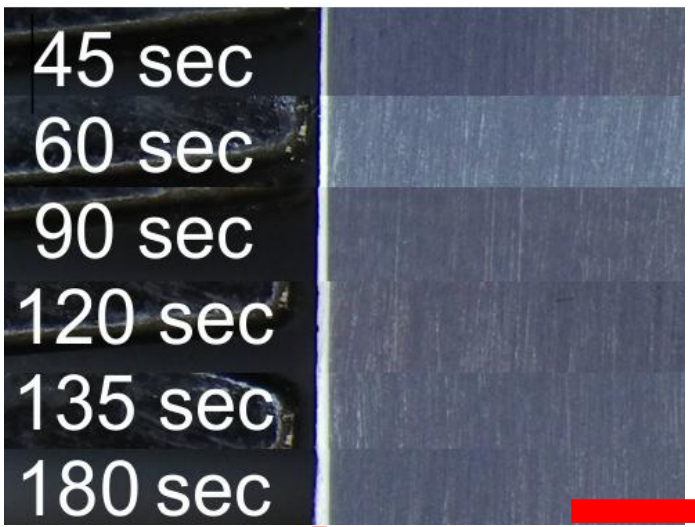


Fig.1, Scintillator surfaces of the 180-second etched strip , obtained using the Hitachi SU8020 scanning electron microscope.



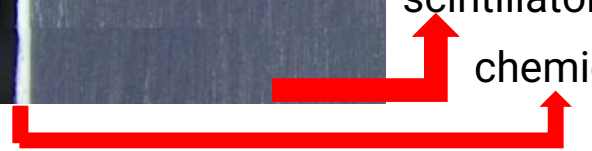
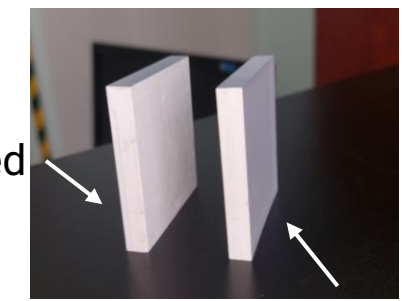
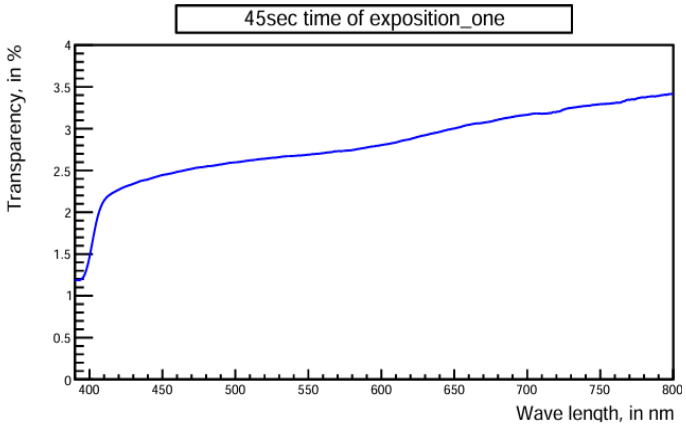
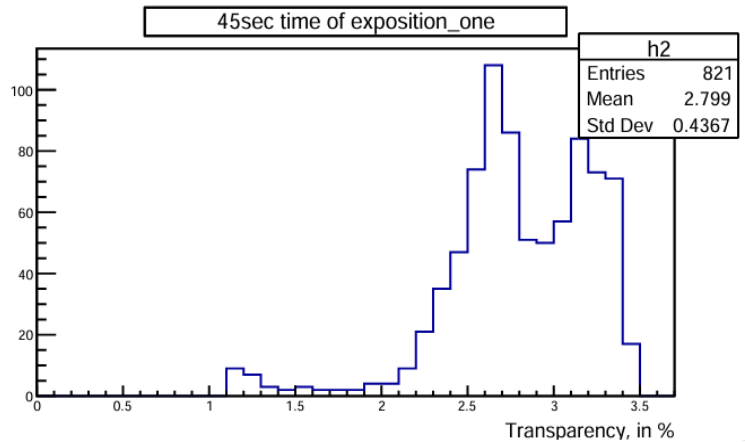


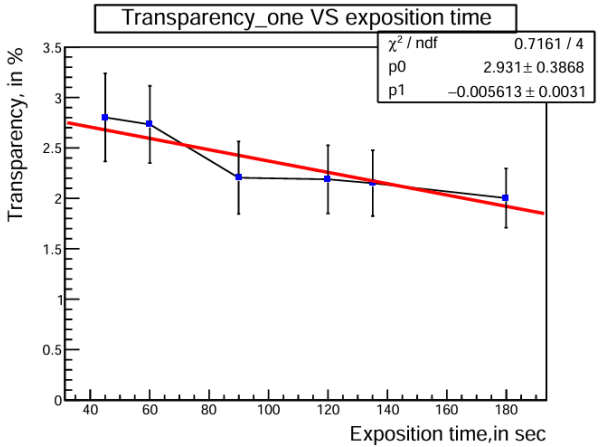
Fig.2, Cross-sectional photographs of the scintillator strip with a reflective layer for samples with different exposure times.(SZM7045)

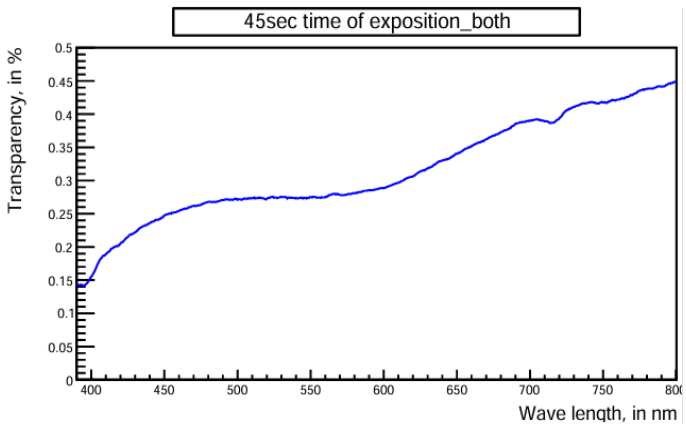


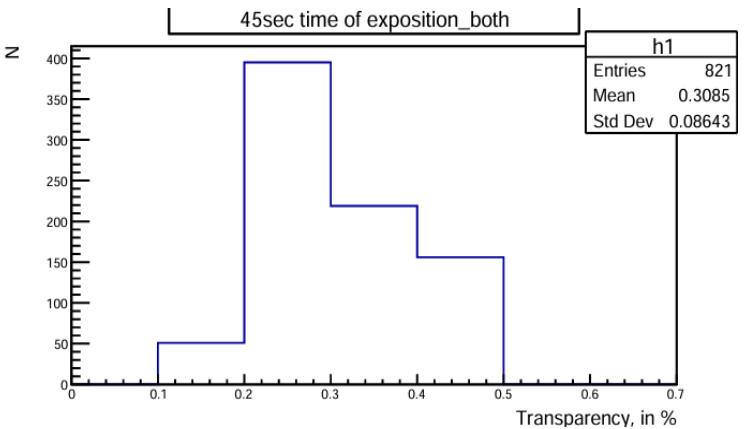
Transparency measurement of reflective layer











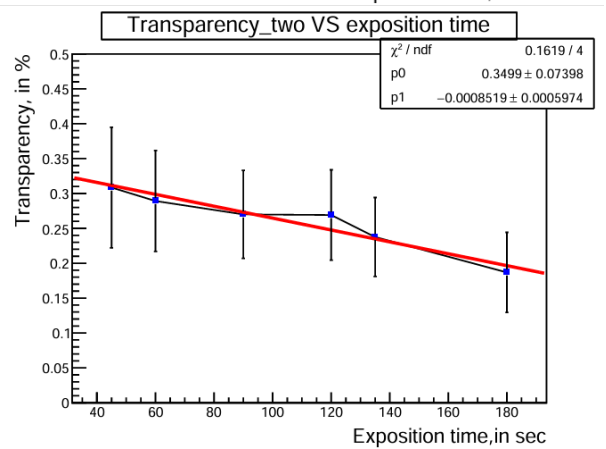


Fig.3, Dependence of transparency on wavelength for samples with different exposure times is presented in the figures.

(SolidSpec-3700DUV – spectrometer)

Transparency/Diffuse reflectance measurement

T_mean	45 sec	60 sec	90 sec	120 sec	135 sec	180 sec
One side	2,273±0,391 %	2,279±0,345 %	1,755±0,285 %	1,783±0,287 %	1,739±0,263 %	1,639±0,25 %
Both sides	0,227±0,042 %	0,222±0,045 %	0,205±0,05 %	0,202±0,053 %	0,1676±0,038 %	0,1319±0,039 %

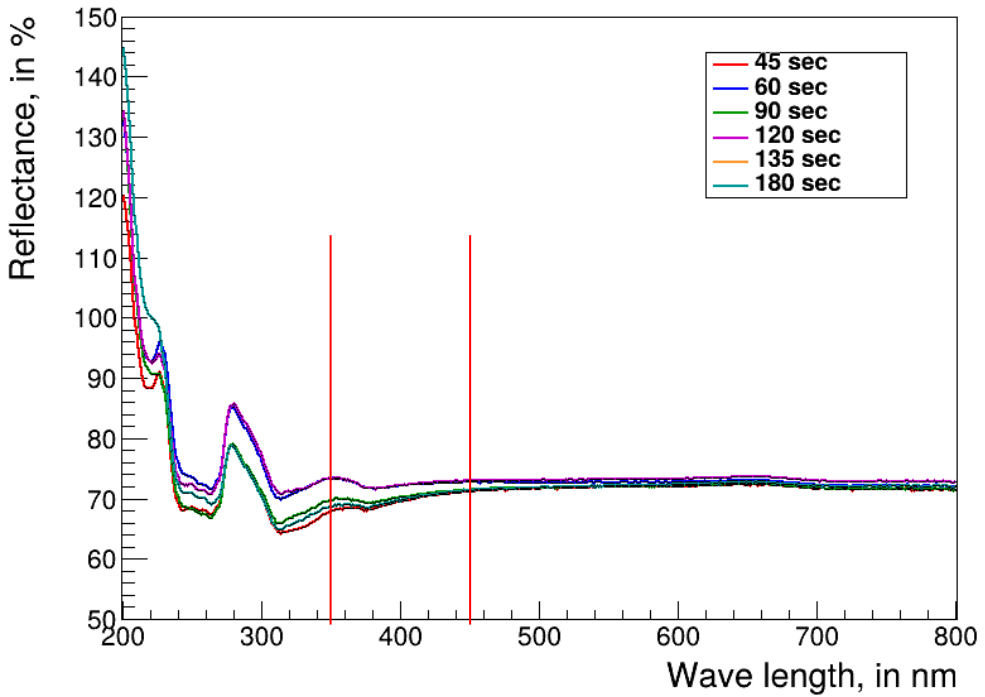
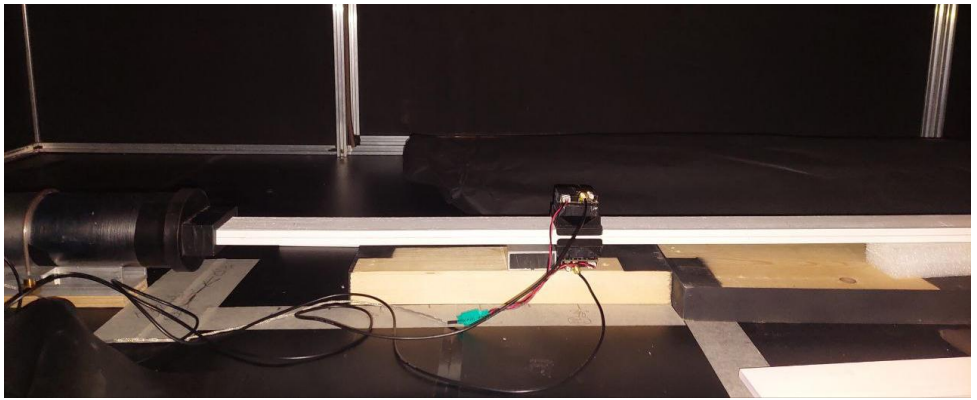


Table 1, of averaged values of Transparency in range (390-800 nm)

Fig.3, Dependence diffuse reflectance on wavelength for samples with different exposure times

(SolidSpec-3700DUV – spectrometer)

Measurement of light collection in samples using cosmic rays



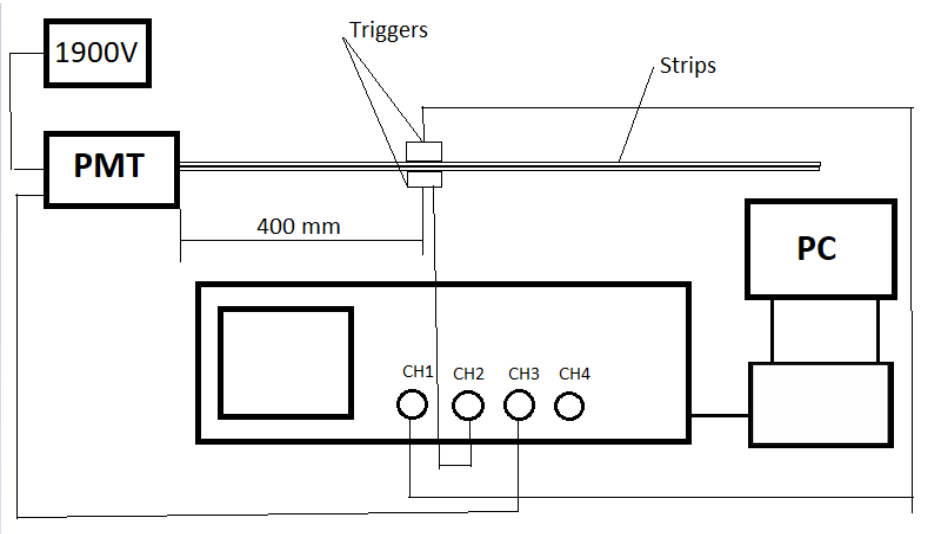


Fig.4, The experimental setup and its principal scheme

The experimental setup consisted of two trigger counters positioned above and below the strip under investigation, as well as a photomultiplier tube (PMT) EM19814.Coincidence of signals from the trigger counters, implemented via an oscilloscope (Teledyne LeCroy), was used to select cosmic particles passing at a distance of 400 mm from the PMT.

Measurement of light collection in samples using cosmic rays



Fig.5, Screen of oscilloscope, Blue-PMT, red and yellow-triggers.

Measurement of light collection in samples using cosmic rays

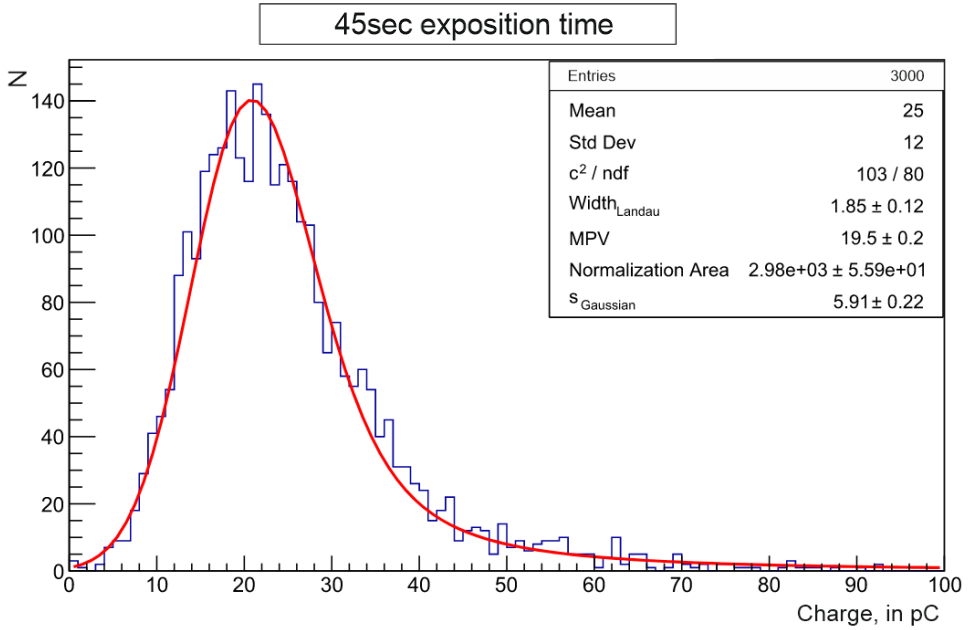


Fig.6, Distribution of the charge in strip(45sec)

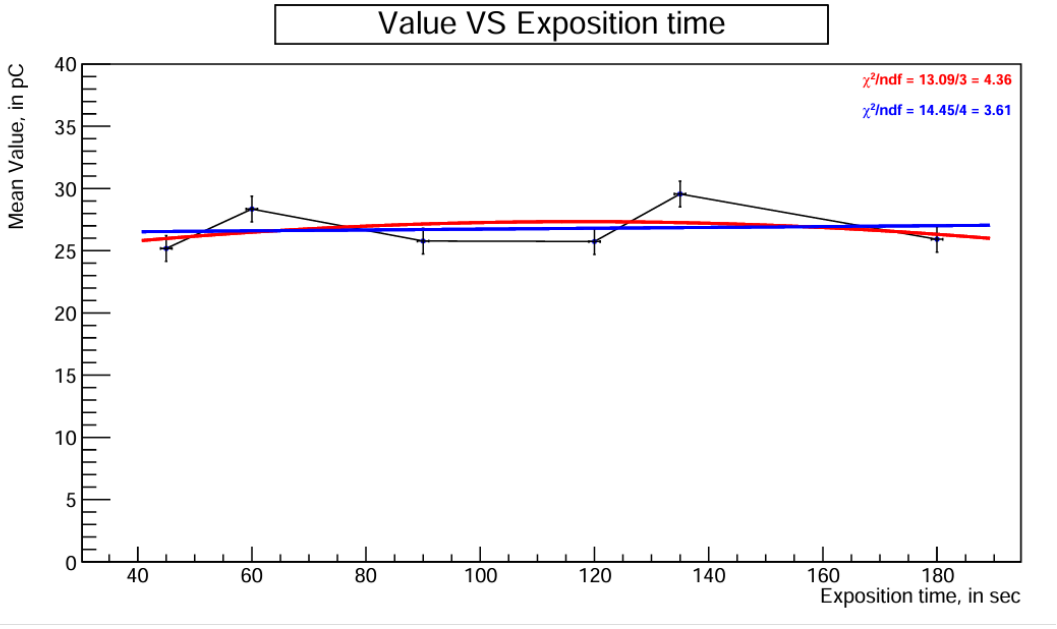


Fig.7, Mean charge value dependance on exposure time

Exposition time [sec]	45	60	90	120	135	180
Mean value [pC]	25.18	28.35	25.78	25.74	29.56	25.92
StdDeev [pC]	12.88	13.79	14.39	14.94	14.55	13.7

Table 2, Mean values of charge and its StdDev for each sample

Conclusion

- Optical parameters of scintillation strip at different exposure times: 45, 60, 90, 120, 135, and 180 seconds were investigated.
- We observed a gradual decrease in the growth rate of the layer thickness with increasing exposure time.
- Transparency also decreases as exposure time increases.
- Optimal etching time could be between 100-135 (based on quadratic fit) and next step is preparing new samples within 100-135 s to verify results.

Thank you for you attention

Bibliography

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