# The method of applying a protective hydrophobic coating on the surface of CsI:Tl scintillator

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Introduction. CsI:Tl crystals are widely used in science and technology as efficient scintillators for the registration and identification of charged particles by atomic number and mass. Due to the significant difference in the signal decay time from gamma quanta, alpha particles, light and heavy ions, the scintillation material CsI:Tl makes it possible to confidently distinguish between particles in the shape of an impulse. The problem of using these crystals is the state of the surface and the appearance of a dead layer near the surface. To ensure the stability of the characteristics, the working surface of the detector is protected by the film, despite the partial absorption of particle energy in the coating. The standard alpha detector (Fig. 1) consists of a 0.35 mm CsI:Tl crystal that is glued to a glass window. At the entrance window for radiation, a varnish (transparent solution of nitrocellulose in acetone) is deposited in a thickness of 5 μm.

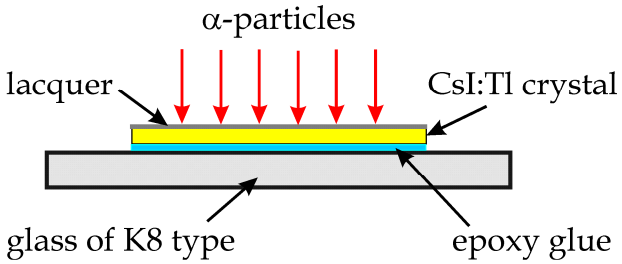


Fig. 1 - Construction of standard α-detector

The purpose of our work was to develop a method of applying a protective coating to the entrance surface of scintillator to reduce the thickness of the hydrophobic film and to improve the spectrometric characteristics of the detector at the registration of α-radiation.
The technique of coating applying. Fluoroplastic varnish is used as a protective coating, which allows improving the hydrophobic properties of the protective film, due to the low water absorption of lacquer. The high transparency of the varnish provides good optical characteristics and photo stability protective coating. The thickness of such coating can be significantly reduced due to the addition of ethyl acetate to its composition. When the solvent is added to the composition of the fluoroplastic varnish, the viscosity of the composition changes, so that the coating is evenly applied to the surface of the crystal. However, high chemical inertness and low surface energy are responsible for the low adhesion of the coating to the surface of the crystal. It has been shown that treatment of polished surface of the CsI:Tl crystal in hexamethyldisilazane (GMDS) vapors can increase the adhesion of the fluoroplastic coating to the crystal due to chemical reactions forming a thin layer of hexamethyldisiloxane on the surface, which is a promoter of adhesion for hydrophobic film of 2 μm in thickness.

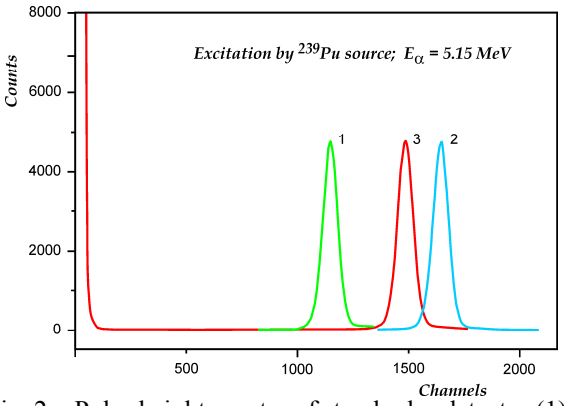


Fig. 2 – Pulse height spectra of standard α-detector (1), without coating (2), after applying fluoroplastic varnish (3)

Results. It has been shown that the light output of a α-detector is increased by 400 channels compared to prototype, and the energy resolution is improved from 6.58 to 5.04 % as it seen from data in table.

Table – Influence of coating contamination on the Light Yield (*L*) and Energy Resolution (*R*) of α-detectors

| Thin film contamination | | Spectrometric characteristics | | Characteristics of protective coating | |
|---|---|---|---|---|---|
| lacquer | solvent | *L*, channels | *R*, % | *d*, μm | continuity |
| 9 | 91 | 1354 | 9,2 | don't | perfect |
| 10 | 90 | **1491** | **5,04** | 1,8 | perfect |
| 12 | 88 | **1480** | **5,09** | 1,9 | perfect |
| 15 | 85 | **1458** | **5,12** | 2,1 | perfect |
| 16 | 84 | 1268 | 6,4 | 3,2 | perfect |
| 10 | 90 | Thin film don't formed without GMDS | | | |
| prototype | | 1155 | 6,58 | 5,1 | perfect |

Data presented in table gives a reason to optimize the compound of proposed composition for hydrophobic protective coating.

Summary. The technique is proposed for applying a protective coating to the entrance surface of CsI scintillator. It has been shown that thickness of the hydrophobic film can be reduced and light yield of crystal can be increased. To improve the adhesion between coating and crystal surface the treatment of polished surface in hexamethyldisilazane vapors is proposed. As a result of using a new type of coating the energy resolution of α-detectors is improved from 6.58 % (prototype) to 5.04 % for proposed coating.