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Composite GYAGG-based scintillation screen for neutron detection

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The present work deals with obtaining neutron sensitive scintillation screens and their evaluation. We have used cerium doped garnet Gd1.2Y1.8Ga2.5Al2.5O12:Ce (GYAGG) as a scintillator since quaternary garnets with the optimized ratio of cations have demonstrated high light yield under γ-quanta and α-particles excitation, 50 000 ph/MeV and 12 000 ph/MeV respectively, with fast decay time (˜50 ns).
We have performed modelling of α-particles and tritons absorption in GYAGG and 6LiF using GEANT 4 software. Then the pathlengths of these particles in GYAGG and 6LiF media were estimated, allowing to calculate of the desired sizes of the scintillator and 6LiF particles and distances between them.
Translucent GYAGG ceramic tablets were prepared and grounded to the required particle size to obtain scintillation pigment. Screens samples with dimensions of 12x12x0.2 mm and phosphor density of ˜50 mg/cm2 with the filling of 90% vol were prepared for light yield evaluation tests under α-particles. 241Am was used as an α-particles source. Scintacor ND neutron screen (6LiF/ZnS:Ag-based) was used as a reference. Pulse height spectra were recorded and peak positions were found to be ˜ 900 channel for ND screen, and ˜111 for GYAGG milled ceramics. ZnS(Ag) light yield under a-particles is known to be 49400 ph/MeV, so considering different PMT efficiency at the emission wavelengths of ZnS(Ag) and GYAGG:Ce3+, we can conclude that the light output of samples made of GYAGG milled ceramics is about 9700 ph/MeV.
The samples for tests under neutrons were prepared according to the simulation results. The composition was: 10 vol.% of scintillator, 30 vol.% of 6LiF, 60 vol.% of a binder. Phosphor layer density was 20 mg/cm2. Pulse height spectra were recorded against the reference screen (Scintacor ND). The total counts in neutron spectra for our best sample and the reference sample were found to be 321 and 299 respectively.

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