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#11-24 PLD-grown, isotopically enriched 10B thin films for thermal neutron detection

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Thermal neutron detection is typically carried out by a double-step process involving neutron conversion reactions leading to secondary charged particles and subsequent detection of the reaction products by means of solid state detectors, scintillators or gas chambers. A proper efficiency thermal neutron conversion material should exhibit a high neutron-capture cross section and optimal detection geometries.
In this paper we report on the deposition by Pulsed Laser Deposition (PLD), homogeneity characterization and performances in neutron detection of 10B neutron conversion layers (isotopically enriched at about 96%). High quality 10B films with thickness ranging from 0.5 to 2 m were deposited by using a 1064 nm Nd:YAG pulsed laser on carbon fiber substrates obtaining a thickness uniformity better than 10% over an area of 30 x 30 mm2. Optimal PLD deposition conditions are presented and discussed based on comprehensive characterization of the boron deposits in terms of laser parameters, elemental composition, surface morphology, deposition rate, thickness uniformity and density.
In order to evaluate the detector performances, all the deposited films were coupled to a 30 x 30 mm2 wide silicon solid state detector and exposed to a neutron flux of ca. 5.6 x 106 neutron/s produced by an AmBe neutron source and moderated by means of polyethylene. The neutron flux on the converter film was measured as 267 ± 5 n/cm2/s by a previously calibrated 6LiF detector. The results, as compared with GEANT4 simulation results, clearly showed the functionality of the proposed set-up and allowed the identification of both and 7Li n-capture products. Encouraging results were also obtained in terms of discrimination against the gamma background radiation associated with both the (n,) reaction and the AmBe source. In particular to get rid of the contribution, an experimental approach where the net neutron counts are obtained by difference between two spectra was developed. A first spectrum is obtained with the detector facing the conversion layer; then a second one with the converter turned upside down so that the detector faces the pristine substrateBased on this approach a detection efficiency in the range few percent was assessed. Future developments are discussed in order to improve the detection efficiency.

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