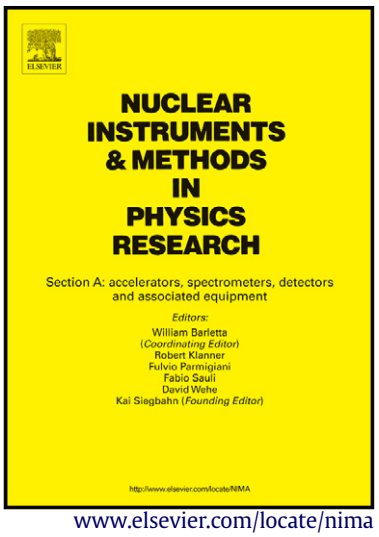

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PII: S0168-9002(15)00255-7
DOI: http://dx.doi.org/10.1016/j.nima.2015.02.045
Reference: NIMA57547

To appear in: *Nuclear Instruments and Methods in Physics Research A*

Received date: 12 September 2014
Revised date: 19 February 2015
Accepted date: 20 February 2015

Cite this article as: T.C. Doan, S. Majety, S. Grenadier, J. Li, J.Y. Lin, H.X. Jiang, Hexagonal boron nitride thin film thermal neutron detectors with High energy resolution of the reaction products, *Nuclear Instruments and Methods in Physics Research A,* http://dx.doi.org/10.1016/j.nima.2015.02.045

Hexagonal boron nitride thin film thermal neutron detectors with high energy resolution of the reaction products

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Hexagonal boron nitride (*h*-BN) is highly promising for solid-state thermal neutron detector applications due to its many outstanding physical properties, especially its very large thermal neutron capture cross-section (~3840 barns for ^{10}B), which is several orders of magnitude larger than those of most other isotopes. The focus of the present work is to carry out studies on *h*-BN thin film and detector properties to lay the foundation for the development of a direct-conversion solid-state thermal neutron detector with high sensitivity. The measured carrier mobility-lifetime ($\mu\tau$) product of *h*-BN thin films grown on sapphire substrates is 2.83 x 10^{-7} cm^2/V for electrons and holes, which is comparable to the value of about 10^{-7} cm^2/V for GaN thin films grown on sapphire. Detectors based on *h*-BN thin films were fabricated and the nuclear reaction product pulse height spectra were measured. Under a bias of 20 volts, very narrow individual peaks corresponding to the reaction product energies of α and Li particles as well as the sum peaks have been clearly resolved in the pulse height spectrum for the first time by a B-based direct-conversion semiconductor neutron detector. Our results indicate that *h*-BN thin film detectors possess unique advantages including small size, low weight, portability, low voltage operation and high energy resolution of specific reaction products.

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