Public Abstract

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Graduation Term:SP 2012
Department:Nuclear Engineering
Degree:PhD

Title:THEORETICAL AND EXPERIMENTAL INVESTIGATIONS IN CHARACTERIZING AND DEVELOPING MULTIPLEXED DIAMOND-BASED NEUTRON SPECTROMETERS

Neutron spectroscopy can be challenging in various environments because of the uncharged nature of neutrons. This means that indirect means are required to detect them. However, gaining energy information about these neutrons due to the indirect nature of detection is problematic for several reasons and are intrinsic to the detection systems. The main obstacles to overcome is intrinsic energy resolution, low detection efficiency, and/or gamma ray sensitivity. To overcome these difficulties this work focused on the development of a diamond-based neutron spectrometer. However, due to the currently available sizes of diamond samples capable of neutron spectroscopy these systems still suffer from low overall detection efficiency. To overcome this final limitation a novel concept of multiplexing was investigated, where diamond plates were connected together electrically such that the multiplexed array acted as a large single crystal diamond as it pertains to neutron detection even though the detection system is comprised of smaller diamond plates. Theoretical results indicate that that the energy resolution from large multiplexed diamond arrays due to charge collection is still below experimentally observed values and that intrinsic detection efficiencies can approach twenty five percent with only minimal secondary neutron interactions. Further, experimental results indicate that the concept of multiplexing works and that the detection efficiency scales linearly with the number of diamond plates in the multiplexed array.