similar to ^{3}He detectors and can be used in large-scale deployment. Accordingly, the present invention relates to a method for detecting slow neutrons, which include the operative steps of: reacting a plurality of slow neutrons with a compound nucleus, wherein the compound nucleus decays into a plurality of particles; exposing the plurality of particles to at least one inert gas, wherein the plurality of particles interact with the at least one inert gas to form at least one excimer; and monitoring the at least one excimer for an optical signal comprising a plurality of photons in the far-ultraviolet region of the electromagnetic spectrum, wherein the optical signal in the far ultraviolet region of the electromagnetic spectrum indicates radiative decay of the at least one excimer, wherein the radiative decay of the at least one excimer comprises emission of the plurality of photons in the far ultraviolet region of the electromagnetic spectrum. More specifically, the compound nucleus is a high-capture cross-section nucleus.

[0014] In one aspect of the present invention, the high-capture cross-section nucleus is selected from a group comprising ^{10}B, ^{6}Li and ^{3}He, and at least one inert gas is selected from a group comprising Ar, Kr, and Xe. In some aspects of the present invention, ^{10}B is in gaseous phase and, in other aspects of the present invention, ^{10}B is in solid phase. In some embodiments of the present invention, the compound nucleus is $^{10}BF_3$. In at least one embodiment of the present invention, the plurality of slow neutrons is a beam line having a diameter of about 4 mm and a fluence rate of about $(2.61\pm0.37)\times10^5$ neutrons/cm^2 s $s^{-1}cm^{-2}$.

[0015] In one embodiment of the present invention, the method for detecting slow neutrons further includes the steps of detecting the plurality of photons in the far ultraviolet region emitted by the radiative decay of the at least one excimer, and determining the number of photons emitted for each of the plurality of the reacted slow neutron.

[0016] The present invention also related to an apparatus for detecting a plurality of slow neutrons, which includes: at least one cell among a plurality of cells, wherein the at least one cell comprising an interaction region for reacting the plurality of slow neutrons with a high-capture cross section compound nucleus and at least one inert gas; a cylinder defining the interaction region, wherein the cylinder is positioned vertically in the center of the at least one cell; an entry port on the at least one cell of the plurality of cells for receiving the plurality of slow neutrons; an exit window on the at least one cell of the plurality of cells for allowing the plurality of slow neutrons to exit the at least one cell of the plurality of cells; at least one detector positioned within a field of view of the interacting region for detecting an optical signal in the far ultraviolet region of the electromagnetic spectrum from the at least one cell, wherein the detector generates a signal upon detection of the optical signal in the far ultraviolet region of the electromagnetic spectrum; and a processor associated with the at least one cell, and the at least one detector for processing the signal generated by the detector to measure slow neutron fluence. More specifically, the exit port is comprised of a material selected from a group consisting of MgF_2, CaF_2, Al_2O_3, SiO_2.

[0017] The apparatus in accordance with an embodiment of the present invention further includes a chamber enclosing a differentially pumped volume for isolating and evacuating the unreacted plurality of slow neutron exiting interaction region. In one embodiment, the apparatus further includes a gas handling system for maintaining a base pressure inside the at least one cell.

[0018] In one embodiment of the present invention, the cylinder is comprised of a material selected from a group consisting of magnesium, aluminum and silicon, and has a diameter of about 25 mm.

[0019] Another embodiment of the present invention relates to a method for detecting slow neutrons, which includes the steps of: reacting a plurality of slow neutrons with a compound nucleus, wherein the compound nucleus decays into a plurality of particles; exposing the plurality of particles to at least one inert gas, wherein the plurality of particles interact with the at least one inert gas to form at least one excimer; detecting an optical signal comprising a plurality of photons in the far-ultraviolet region of the electromagnetic spectrum, wherein the optical signal in the far ultraviolet region of the electromagnetic spectrum indicates radiative decay of the at least one excimer, wherein the radiative decay of the at least one excimer comprises emission of the plurality of photons in the far ultraviolet region of the electromagnetic spectrum; and processing the optical signal comprising the plurality of photons in the far-ultraviolet region of the electromagnetic spectrum to measure slow neutron fluence. More specifically, the compound nucleus is a high-capture cross-section nucleus, and is selected from a group comprising ^{10}B, ^{6}Li, and ^{3}He. In one aspect of the present invention, the at least one inert gas is selected from a group comprising Ar, Kr, and Xe.

[0020] In one embodiment of the present invention, the method for detecting slow neutrons further includes the step of determining the number of photons emitted for each of the plurality of the reacted slow neutron.

BRIEF DESCRIPTION OF DRAWINGS

[0021] FIG. **1** illustrates a slow neutron detection apparatus in accordance with an embodiment of the present invention.

[0022] FIG. **2** illustrates a reaction cell of a slow neutron detection apparatus in accordance with one embodiment of the present invention.

[0023] FIG. **3** illustrates a reaction cell of a slow neutron detection apparatus in accordance with another embodiment of the present invention.

[0024] FIG. **4** illustrates emission spectra of excimers produced by passage of charged particles through rare gases in an exemplary embodiment of the present invention.

[0025] FIG. **5** illustrates detector response as a function of wavelength in an exemplary embodiment of the present invention.

[0026] FIG. **6** illustrates a comparison of signal obtained using a slow neutron detection apparatus in accordance with an embodiment of the present invention with expected signals obtained from modeling results.

[0027] FIG. **7** illustrates the number of photons produced for each neutron reacted in an exemplary embodiment of the present invention.

DETAILED DESCRIPTION

[0028] As used throughout the disclosure, the following terms, unless otherwise indicated, shall be understood to have the following meanings.