

## **NEUTRON AND GAMMA RAY SPECTROSCOPIC DETECTION SYSTEM**

The Domestic Nuclear Detection Office's mission is to improve the nation's ability to detect unauthorized nuclear importation, and the office was allocated \$1.2 billion to accomplish its goal. The office has invested heavily in advanced spectroscopic portals, but these have turned out to have very low detection efficiencies despite the fact that they cost nearly \$400,000 a piece. However, the office continues to search for new technologies that adequately detect neutrons. This invention, developed at this premier nuclear engineering school with the largest research reactor in the country, proposes a novel solution for neutron detection.

Diamond based detection systems are becoming popular with the technological advances in CVD diamond film growth technologies. Within the past ten years, diamond film purities have reached levels that allow undoped diamond plates to be used as an intrinsic semiconductor. With this, several charged particle and ultra-violet detection systems have been developed, along with a few neutron detection systems. Neutron detection utilizing diamond use neutron absorption into carbon for fast neutron detection. However, the cross section for this detection mechanism is small and so these detection systems are limited in their active detection volume. If the volume of the diamond detection medium were increased, then this detection mechanism would become advantageous. Even more so, the elastic scattering cross section of neutrons from diamond is higher than that of neutron absorption and does not have a 5.7 MeV threshold. Therefore, by increasing the diamond detection volume, another avenue of detection and spectroscopic determination of neutron sources becomes available. There are two ways of doing this, through advancing the CVD growth technology limitations, or through innovation. Here, a plate combination mechanism is proposed that allows the increase in the active detection volume while maintaining all other characteristics of single diamond plates.

### **POTENTIAL AREAS OF APPLICATIONS:**

- Homeland Security (sea ports, airports, border crossings)
- Nuclear reactor design and management

**PATENT STATUS:** Provisional patent application to be filed

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