PhD Thesis Title: Fabrication and characterization of a 3D Positive ion detector and its Applications

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ABSTRACT:

There is a growing interest to experimentally evaluate the track structure induced by ionizing particles to characterize the radiobiological quality of ionizing radiation for applications in radiotherapy and radiation protection. To do so, a novel positive ion detector based on the multilayer printed circuit board (PCB) technology has been proposed previously, which works under the principle of ion induced impact ionization. Based on this, an upgraded 3D positive ion detector was fabricated to improve its efficiency and be used in various applications. To improve the efficiency of the detector, cathodes with different insulators (Bakelite plate and Steatite Ceramics) and conducting layers (ITO, FTO, and Gold coated cathode) were studied under various gaseous media (propane, methane, argon, nitrogen, and air) using Am-241, Co-60, Co-57, Na-22, Cs-137, and Ba-133 sources. From this study, it is confirmed that the novel 3D positive ion detector that has been upgraded using gold as strip material, tungsten (87 %) coated copper (13 %) as the core wire, gold coated ceramic as cathode, and thickness of 3.483 mm showed 9.2% efficiency under methane medium at 0.9 Torr pressure using an Am-241 source. It is also confirmed that when the conductivity of the cathode and thickness of the detector is increased, the performance of the detector is improved significantly. Further, the aim of the detector to use in the field of radiation protection, radiation dosimetry, gamma spectrometry, radiation biology, and oncology are reported in detail in the PhD thesis.

References to author publications that relate specifically to the dissertation:

1. **P. Venkatraman** and C. S. Sureka, "An In-Vitro study for early detection and to distinguish breast and lung malignancies using the PCB technology based nanodosimeter." Scientific Reports, 9:380, 1-16, (2019).
2. **Pitchaikannu Venkatraman** and C. S. Sureka, "Analysis on the performance of a 3D positive ion detector as propane and argon sensor." Accepted by the Nuclear Inst. and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, https://doi.org/10.1016/j.nimb.2018.11.037
3. **Pitchaikannu Venkatraman** and C. S. Sureka, "Analyze the positive ion detector in terms of thickness." Accepted by the Nuclear Inst. and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms, https://doi.org/10.1016/j.nimb.2018.09.019

4. **Pitchaikannu Venkatraman and** Chandrasekaran Senbagavadivoo Sureka, “Fabrication and characterization of a 3D Positive ion detector and its applications.” Nuclear Inst. and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 872 (2017) 131–138.