Development of large area silicon alpha particle detector.

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Accidents at nuclear power plants like in Chernobyl and Fukushima have led to radioactive contamination with a wide variety of gamma and beta emitting radioisotopes (e.g.Cs-137, I-131 etc) as well as with alpha active nuclear fission products of the blown out reactor fuel. The most active alpha emitting radioisotopes found on soil after the Fukushima accidents are ^{238}U, ^{235}U, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{241}Am, ^{244}Cm. Highly efficient alpha detectors with a good energy resolution are required for in field and laboratory measurements of contaminated soil samples and plants.

A large area, 5 cm^2, silicon ion implanted alpha particle detector has been developed at the Centre for Medical Radiation Physics in collaboration with its exclusive microelectronic detector foundry SPA BIT. The detector has the advantage in that the detector surface is easily cleanable with chemicals (no deterioration of spectroscopy and electrical properties) and it has good energy resolution in comparison to an ionization chamber with a thin and fragile entrance window.

This detector was investigated using Current-Voltage (I-V) and Capacitance-Voltage (C-V) characteristics. It demonstrated 15 nA reverse current under a bias of 60 V which provides a depletion depth of 150µm and saturation of charge collection under broad alpha beam irradiation from ^{241}Am □-source. The uniformity of charge collection and energy resolution investigated with a collimated 1 mm diameter alpha beam of ^{241}Am source with a 3 mm air gap along the perpendicular diameters was 1.5 ± 0.5%. Detailed measurements of charge collection efficiency and uniformity of the entrance window of the detector using IBIC ANSTO probe with 5.5 MeV alpha micro beams will be presented. The detector developed is a useful means to measure alpha activity of contaminated soil following a nuclear accident as a part of portable spectroscopy setup.

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[2] Determining the impact of Alpha-Particle emitting contamination from the Fukushima-Daiichi Disaster on Japanese Semiconductor Manufacturing Sites by Robert Baumann, 2011.
[3] Introduction to charge-particle detector by Ametek Advanced Measurement Technology, 2011.