Neutron-insensitive silicon ion detectors for NPA (Neutral Particle Analysis)

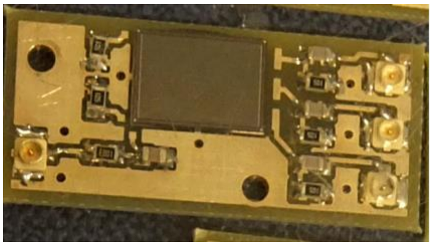
A leading European nuclear fusion institute has developed a thin silicon strip detector for 10-1000 keV ions. The detector consists of an active silicon layer (5 µm thick for low-energy ions, or 25 µm thick for detection of high--energy ions) bonded to a silicon support (~300 µm thick). Unlike previous ion detectors, the thin silicon strip detector exhibits high background-to-signal separation and good radiation tolerance, so is effective in high gamma, neutron, or photon backgrounds. The detector works by converting ion energy directly to charge in the silicon.

Description of the technology

A world-class European nuclear fusion institute has developed a thin silicon strip detector for use with 10-1000 keV ions in high neutron, photon, or gamma backgrounds. Good background-to-signal separation and high radiation tolerance can be achieved as the detector is only weakly sensitive to photon, neutron, or gamma backgrounds but detects high-energy ions efficiently.

The detector consists of an active high-resistive silicon layer bonded to a silicon substrate. In the existing prototypes, the active layer is 5 µm (microns) or 25 µm thick, with a silicon--on--insulator (SOI) substrate of several hundred microns.

These thin silicon detectors are used to monitor the energy distribution of ions in the plasma of the JET tokamak. The different detector thicknesses allow relatively close matching of thickness to the ion range in silicon, resulting in good signal-to-background discrimination: the 5 µm layer is used for low-energy ions, while the 25 µm layer detects high-energy ions.



Thin silicon strip detector mounted on a 15X40 mm PCB for use in JET NPA (courtesy of EDFA)

Innovation and advantages of the offer

The thin silicon strip ion detector has many advantages over the previous technology (a scintillator--PMT combination), including: good signal-to-background separation, high energy resolution, identification of different ions, good radiation tolerance, direct conversion of ion energy to current pulse, low-voltage operation, low power consumption, insensitivity to voltage variations.

Non-fusion Applications

Current and potential applications are plasma processes including: nuclear fusion applications – monitoring of energy distribution of plasma ions, ion identification; linear profiling of ion, optical, or low-energy X-ray (~10 keV) sources

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