RECENT ADVANCES IN AVALANCHE PHOTODIODES FOR PARTICLE DETECTION

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The development of high performance detectors in the medium-energy range particles, from 1 to 100 keV or keV/n, has been a primary driving force for research on thin dead-layer, thick-depletion avalanche photodiodes (APDs). It is difficult to accurately and reliably detect electrons in medium-energy range, since this range borders the techniques for lower-energy and higher energy. The APD is a type of solid state detectors (SSDs) having internal gain due to the avalanche amplification. Electron-hole pairs produced by injected particles are accelerated to create an avalanche of charges in the strong electric field inside the APD. This internal gain enables better energy resolution with lower threshold of detectable energy compared to conventional SSDs. APDs are already applied to measure electrons with good linearity and high energy-resolution over medium-energy range. Recently, the large sampling area has achieved in view of coupling with electrostatic analyzers or magnets in order to prevent lights or other noise sources. Owing to the intrinsic performance of APDs, there are some environmental limitations. The temperature dependence and the radiation tolerance (^{60}Co) were tested assuming the practical environments in space with optimistic results for countermeasures. In addition to electron measurements, those thin dead-layer APDs are also applicable to low-energy ions. Here we show the ion measurement result of APDs for energies lower than 50 keV. This paper reviews some of the recent progress in APDs as particle detectors and discusses possibilities of APDs in the future application.

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