ABSTRACT

The invention — microchannel avalanche diode, belongs to semiconductor photosensitive devices, and specifically to semiconductor avalanche diodes with internal amplification of the signal. The proposed microchannel avalanche diode can be used for registration of super feeble light pulses, including up to individual photons, and also gamma quants and charged particles in devices for medical gamma tomography, radiation monitoring, and nuclear physics experiments.

The characteristic feature of the proposed device is that in the avalanche photodiode, containing a substrate and semiconductor layers with various electro-physical properties having common interfaces both between themselves and with the substrate, at least one two-dimensional matrix of separate solid-state areas — islets with enhanced conductivity for the creation of potential micro-holes is formed. In order to reduce the generation current in the volume and to improve the homogeneity of the distribution of the potential along the surface of the device, the solid-state areas are situated between two additional semiconductor layers having enhanced conductivity with respect to the semiconductor layers with which they have common interfaces. As a result, such form of distribution of the potential in the volume of the device is achieved, which ensures the gathering of the photoelectrons towards the separate solid-state areas where avalanche amplification of the charge carriers with their subsequent accumulation in the corresponding micro-holes is taking place. The charge accumulated in the micro-holes decreases the electric field in the avalanche area, which leads to self-extinguishing of the avalanche process. Then the charge carriers flow to the contacts, thanks to sufficient leakage in the micro-holes.

In this way, amplification of the photoelectrons takes place in independent multiplication channels with subsequent self-extinguishing of the avalanche process. Thanks to that, the stability of the amplitude of the photo-response is improved and the sensitivity of the avalanche photodiode is increased.



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