Semiconductor Particle Detector Device

This radiation-resistant semiconductor device is integrated into standard CMOS manufacturing technology. It acts as an active pixel in imaging detectors. It is capable of capturing images by detecting charged particles with energies in the range of 1 to 10 KeV. Its operation is based on measuring the electrostatic charge generated in a capacitor when it is irradiated by radiation. It uses MiM capacitors available in standard CMOS processes. The device can detect and measure both the sign and variations of the charge induced on a floating metal electrode. The pixel distribution allows the spatial distribution of the ionizing radiation flux to be measured.

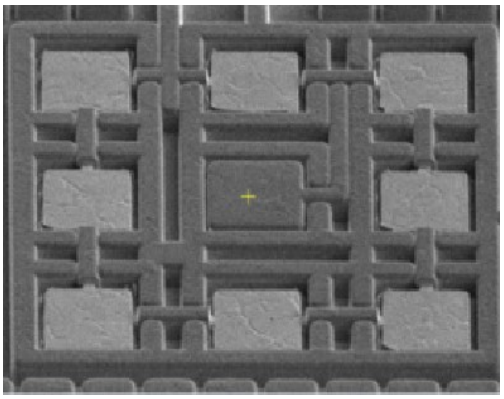
An offer for Patent Licensing

Radiation-resistant pixel particle detector compatible with standard CMOS manufacturing processes

Semiconductor Pixel Detectors (SPDs) are essential tools for imaging ionizing particles over a wide range of energies. Each pixel performs two tasks: sensing radiation and amplifying/transmitting the resulting signal. However, this electronic part can be damaged by the same radiation it senses.

Most significant radiation-tolerant techniques carry numerous disadvantages that the proposed innovative device overcomes. It employs a floating metal electrode that collects charges from both absorbed particles and secondary electrons generated by the radiation. In addition, for precise control and greater detection range, it uses capacitors in parallel to the amplifier to adjust the gain when a specific threshold is exceeded. This approach overcomes the linearity in radiation-to-signal conversion of common detectors, such as photodiodes.

The great advantage is that they use elements that are compatible with standard CMOS planar integration processes, which reduces costs and undesirable noise originated during manufacturing. This method also minimizes inter-device variability, ensuring more consistent performance.



Top View of the Pixel: Several capacitors connected in parallel are visible, along with 30 distributed ones centered around the feedback capacitor.

Main innovations and advantages

- Simple Manufacturing: Allows to create radiation robust semiconductor detectors (SPDs) using standard planar CMOS technologies. It doesn't require more expensive vertical integration technologies.
- Power Flexibility: Works well with DVS architectures, automatically adjusting its power according to the detected load, for greater efficiency.
- Metallic Protection: A metal-coated electrode reduces electrical leakage, dissipates heat, and withstands radiation. It can even operate in a vacuum. The circuitry is placed beneath the electrode and remains shielded.
- Effective Amplification: Generates secondary electrons that increase the detected signal, improving its sensitivity.
- Efficient and Precise Detection: Its low capacitance design reduces sensitivity to temperature and manufacturing processes, thereby reducing noise and enhancing signal quality.

Patent Status

Spanish Patent Application

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