Nuclear Semiconductor Detectors Encyclopedia Article

Nuclear Semiconductor Detectors

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Nuclear Semiconductor Detectors

The invention of transistors by William Shockley in 1948 created a revolution in many aspects of human society, from pure scientific research to a host of everyday applications. The utility of Shockley's transistor was greatly advanced by Leo Esaki's (1925-) discovery a year later of the tunnel diode. Tunnel diodes are able to perform many of the functions of a conventional transistor, but with much smaller size and much greater speed.

One application of the Shockley-Esaki discoveries has been in the field of particle detection. The nuclear semiconductor detector first became available in 1958. It consists of a p-n semiconductor combination separated by a thin depletion (insulating) region. Passage of radiation through the detector creates ions that initiate the movement of electrons and *holes* in the depletion region. In some cases, the electric current thus generated is read and recorded directly. In other cases, the current is amplified before being registered.

Semiconductor detectors have a number of advantages over other types of particle detectors. For example, the energy needed to produce an electron-hole pair is only about one-tenth that needed to produce ionization in a gas (as required, for example, in a Geiger counter). Also, since the solids of which a semiconductor detector are made are about 1,000 times more dense than a gas, these devices can be made much smaller than a Geiger counter, spark chamber, or cloud chamber.

Semiconductor detectors have become among the most widely used of all kinds of radiation detectors. They have found application in both basic and applied research in biology, environmental sciences, medicine, and space studies.