Possibility of making semiconductor-based sensors autonomous in energy by means of energy harvesting in a nuclear environment

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One way to ensure the long-term operation of an electronic device is to power it by using ambient energy harvesting. Different forms of energy harvesting methods are known and already exploited in equipment, such as photovoltaic panels, thermoelectric generators, or radio-frequency antennas. The principle is to generate electrical power by converting the solar, mechanical or electromagnetic energy into direct current electricity.

We propose energy harvesting based on the use of ionization trails produced by a high flux of ionizing radiation as it passes through a sensitive material. More precisely, the objective is to harvest the ionization current produced by the primary electron-hole pairs moving under the "diffusion" electric field present at a pn junction.

We present the results of the tests carried out in order to prove the validity of our idea [1]. We describe the experimental setup that we have built, in particular the 3D printed mechanical system designed to control the location of the radioactive source in front of the semiconductor device under test. The tests are based on real-time characterization of the electrical response of the irradiated device. For that, open-source software [2] was written permitting a remote control of the measurement instrument [3]. Our investigations show that commercial photodiodes generate a few pA dc, enough to power integrated analog blocks.

References

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