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Sub-MM Wireless Ionizing Radiation Detector

Radiation dosimeters are devices used to measure exposure to ionizing radiation such as, X-rays, alpha and beta particles, and gamma rays. The damage that this radiation can cause to a material (e.g., human tissue) is typically cumulative, related to the total ionizing dose received. Therefore, workers who are exposed to ionizing radiation are usually required to carry a dosimeter. Microscale dosimeters are being developed for high-dose applications, such as radiotherapy and space flight. Common solid state dosimeters include PIN diodes and radiation sensing field effect transistors (RADFETs). Although PIN dosimeters are accurate, they are typically more appropriate for measuring dose rate not cumulative dose. They also dissipate power during exposure. RADFETS, on the other hand, require no power to store/write the radiation does information. However, they require a significant power to read the exposure dose. Furthermore, the devices are relatively large (approximately 20mm by 2mm), thus for radiotherapy applications, their geometry may not allow sufficient spatial resolution, and the devices are not implantable.

To address these issues, Dr Hugh Barnaby at Arizona State University has developed a radiation sensing MOS capacitor (RADCAP). The RADCAP can be coupled to a passive patch antenna, resulting in a form factor less than 1mm2. The device is a passive device, reducing circuit complexity. Radiation-induced changes to the RADCAP capacitance can be measured wirelessly.

Potential Applications

- Homeland security ? monitors covertly applied to shipping crates can provide covert threat detection at port-of entry.
- Radiation therapy ? implantable devices for dose measurements during radiation oncology treatments.
- Personal dosimeter for civil accident and military battlefield.
- Nuclear power stations and nuclear waste cleanup.
- Space vehicle health monitor
- High energy accelerators ? dose mapper for crystals

Benefits and Advantages

- Small size ? more readily implantable and also allows covert use.
- Low cost ? small size and passive operation, fabrication in CMOS foundry flow
- Fully passive operation ? chip requires no static/dynamic power during data acquisition and transmission.
- Non-volatile data storage ? zero static power for data storage
- Ease of fabrication ? fully compatible with conventional silicon IC technology.
- Unique ID tags ? designer device capacitances allow different frequency responses.