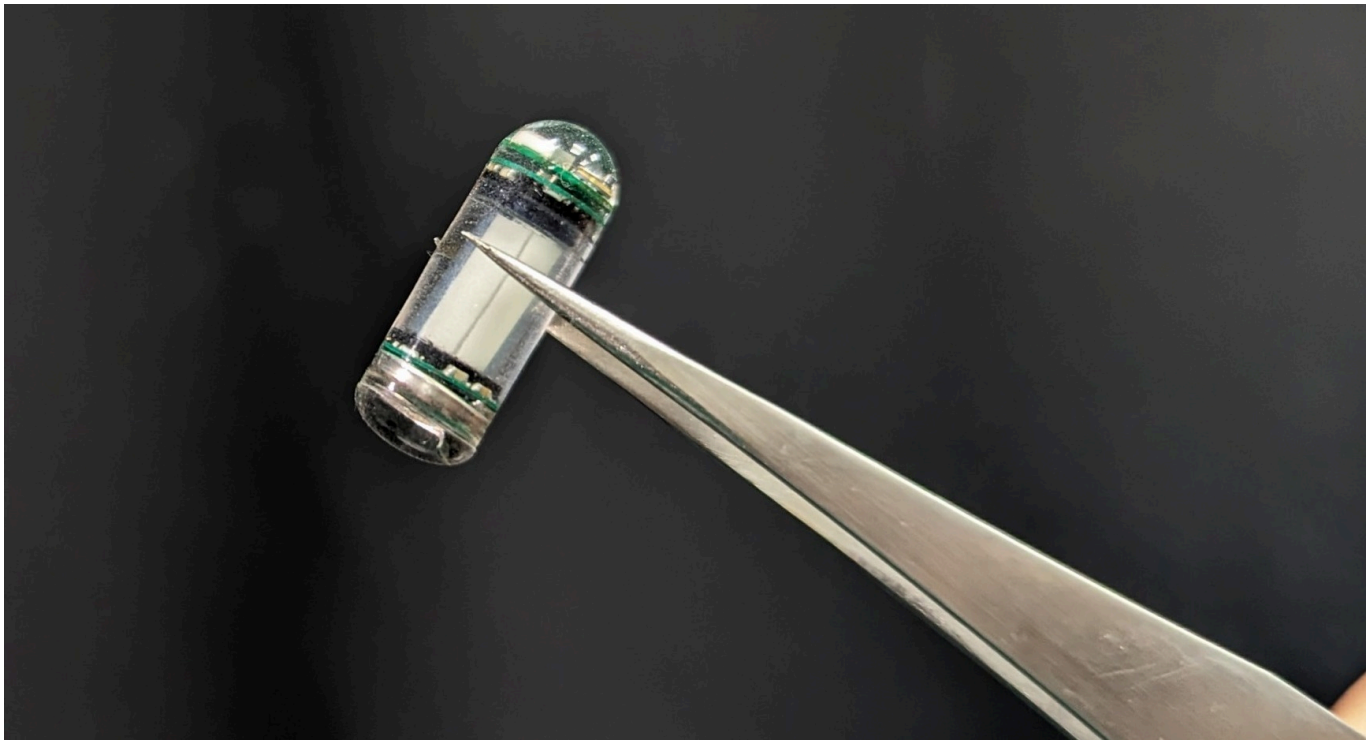
TECH OFFER

Novel Ingestible Capsule X-ray Dosimeter for Real-Time Radiotherapy Monitoring



KEY INFORMATION

TECHNOLOGY CATEGORY:
Healthcare - Diagnostics
Healthcare - Medical Devices
Healthcare - Telehealth, Medical Software & Imaging

TECHNOLOGY READINESS LEVEL (TRL): TRL4
COUNTRY: SINGAPORE
ID NUMBER: TO174979

OVERVIEW

In radiotherapy for patients with gastrointestinal (GI) cancer, real-time, continuous monitoring of X-ray radiation in the GI track can greatly improve the precision of the treatment. This proposed technology consists of a swallowable X-ray dosimeter capsule for real-time monitoring of absolute absorbed radiation dose and changes in pH and temperature in the GI tract. Using a neural network-based regression model and a luminescence of nanoscintillators fiber, the capsule is able to estimate radiation dose from radioluminescence and afterglow intensity and temperature. Initial preclinical study in a rabbit model showed that the dosimeter was approximately five times more accurate than standard methods for dose determination. Hence, these swallowable dosimeters may help to improve radiotherapy and understand how radiotherapy affects tumour pH and temperature.

The technology owner is seeking for collaborations and out-licensing with medical institutions and medical device companies for clinical testing and further research identifying the capsule's position and posture after ingestion, developing a robust positioning system.

TECHNOLOGY FEATURES & SPECIFICATIONS

The capsule hardware includes a highly sensitive optical fiber embedded with NaLuF4:Tb@NaYF4 nanoscintillators for monitoring low dosage of X-rays, a pH-responsive polyaniline-coated film, a customized multi-inlet microfluidic module for dynamic gastric juice sampling, two colour sensors with integrated temperature sensors, a small-sized PCB board with MCU, and a button-sized silver oxide battery. The capsule software includes APP for data collection, storage and analysis. The capsules can monitor dose, pH change and temperature on the spot in real time, and the size is small (close to the dimensions for standard size 2 capsule: 16 mm length and 7 mm outer diameter).

POTENTIAL APPLICATIONS

The capsule dosimeter can be easily inserted into the rectum to monitor brachytherapy for prostate cancer. With further size optimization, the capsule could be placed in the upper nasal cavity to allow accurate real-time measurement of effective radiotherapy dose in nasopharyngeal or brain tumors, minimizing radiation damage and possible side-effects to surrounding structures. This technology can be adapted for the development of highly sensitive in vivo sensors on gas molecules, reactive oxygen species, and other physiological or biochemical indicators.

MARKET TRENDS & OPPORTUNITIES

To the best of the knowledge, there is no electronic capsule on the market that monitors dose delivery, pH and temperature during radiotherapy. The technology will be the first method to integrate an X-ray detector with pH and temperature detectors. In addition, the proposed technology enables X-ray detection with much higher sensitivity than other technologies.

According to a market report, the cost of radiotherapy is between USD$10,000 to USD$50,000, depending on the type of cancer, number of the treatments needed, and the type of radiation used. The cost of the capsules to monitor the accuracy of radiotherapy is less than USD$200. This market is expected to reach $279.16 million by 2025, with an estimated CAGR of 12% from 2021 to 2025. In vivo monitoring of dose delivery, pH, and temperature during radiotherapy is essential for smart medical applications.

UNIQUE VALUE PROPOSITION

The ingestible electronic capsule that enables multifunctional characterisation is of high detection sensitivity, low cost, and simple manufacturing process.

This technology offers the following benefits:

- High sensitivity: Synthesized materials are sensitive to X-rays.
- Small size: Patients can swallow comfortably.
- Low power consumption for long-term monitoring of pH, dose and temperature.
- Suitable for in vivo test and real-time detection of dose and pH changes during radiotherapy.