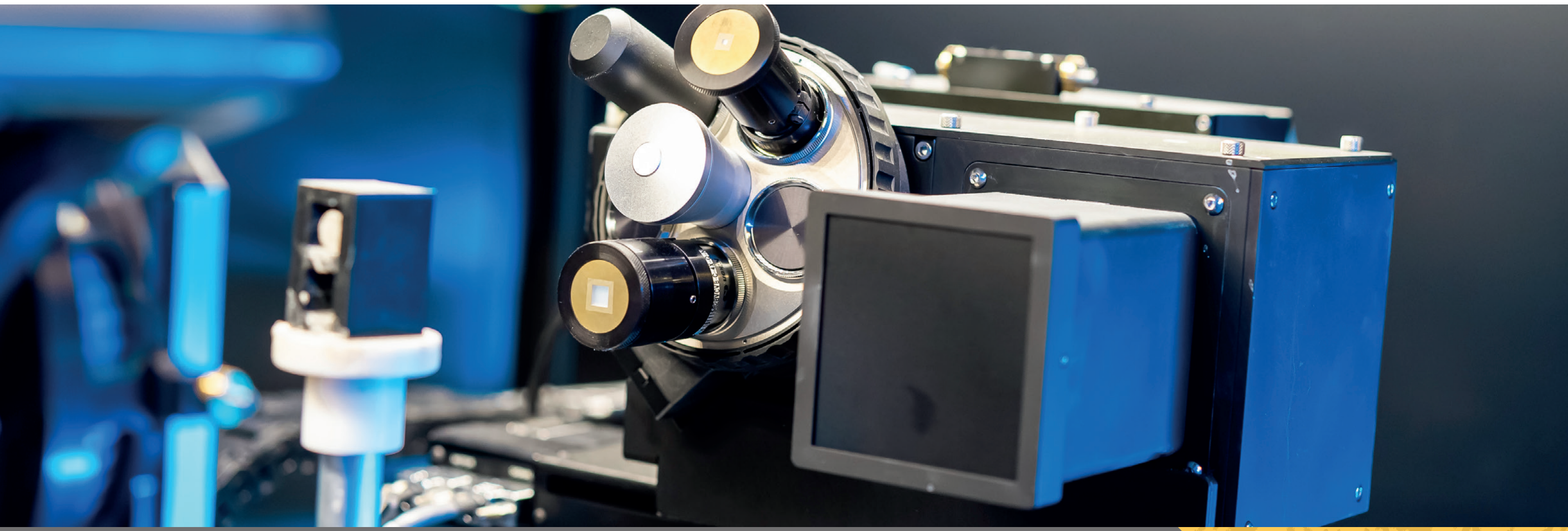
Advancements in next-generation X-ray detectors to enable better disease prevention

Preventative healthcare screening is key to early disease detection. Photon-counting computed tomography could revolutionise screening, but current CT detectors prevent this technology's advancement. Clarity Sensors used the Royce X-Ray CT microscope to develop next-next-generation X-ray detectors that reduce radiation dose and enhance image quality, paving the way for widespread preventative CT screening.



3D X-Ray Computer Tomography

The Royce Cambridge CT Microscope is a ZEISS Versa 510 used for non-destructive, in-situ characterisation and observation of the composition, deformation and damage development of a broad range of materials. Samples can be as small as tens of microns to several inches. The stage can handle up to 15kg, custom stages can be developed.

Our CT microscope can view deeply buried microstructures that may be unobservable with 2D surface imaging. It can also be used for investigating samples with features on length scales from 50 microns down to 1 micron.

University of Cambridge is a Partner of the Henry Royce Institute for advanced materials

HEADING

The main challenge for photon-counting CT detectors lies in the active semiconductor sensor, Cadmium (Zinc) Telluride (CdZnTe). Medical-grade Cd(Zn)Te requires costly, complex manufacturing at high-temperatures for several months. Consequently, there are only 3 global suppliers, hindering wide-spread adoption. Additionally, current CT detectors need high X-ray doses, posing health risks and limiting expanded use for widespread preventative screening.

To overcome these challenges, new semiconductor-based detectors which lower X-ray doses, enhance image quality, and simplify manufacturing are needed. The Royce Ambient Processing Cluster Facility and XRCT provided advanced fabrication and characterisation capabilities to progress the optimisation of our low-temperature semiconductor X-ray detectors.

RESULTS

Clarity Sensors optimised fundamental material composition and detector interlayer architectures. The results contributed to the development of an IP and will be published in a high impact journal. This technology can revolutionise medical imaging by enabling lower-dose, higher-resolution CT scans drastically reducing radiation exposure through CT scanners. This could expand preventative screening across various cancers and cardiovascular conditions while supporting less invasive methods such as CT colonography and CT mammography

“By drastically reducing radiation exposure, we envision a future where ultra-low-dose CT imaging enables high-throughput, walk-through scanners, making routine health screenings as accessible as airport security checks”

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“The support from the Royce ICP fund was vital in advancing our X-ray detector technology and Clarity Sensors. Access to state-of-the-art facilities, including the XRCT and Ambient Processing Cluster Facility, greatly enhanced device fabrication and characterisation, accelerating prototype development and strengthening opportunities for further grant funding and investment. The expertise, guidance, and training from the Royce Facility Managers was invaluable, ultimately advancing our transformative X-ray detectors and bringing them one step closer to market and towards substantial future healthcare benefits.”

Hayden Salway
Research Associate, University of Cambridge & CEO, Clarity Sensors

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