UNIVERSITY OF CALIFORNIA SANTA CRUZ OFFICE OF RESEARCH



# Scalable, Multi-Energy Detection and Imaging

Tech ID: 34721 / UC Case 2025-943-0

## BACKGROUND

Comprehensive radiation detection across the spectral range requires distinct systems for ionizing and non-ionizing imaging because each technology faces unique architectural hurdles. Modern visible light detection has successfully transitioned from passive plates to digital Active Pixel Sensors (APS) by leveraging Complementary Metal-Oxide-Semiconductor (CMOS) technology to provide every pixel with its own dedicated amplifier and active circuitry. Ionizing radiation detection like X-ray and gamma-ray has relied on exotic scintillators to convert radiation into light, a process prone to lateral light scattering and degraded spatial resolution. Recent advancements in ionizing radiation have shifted toward direct conversion materials like amorphous selenium (a-Se), which transform X-rays directly into electrical charges. However, these direct-conversion devices do not scale to larger areas without significant noise being a factor. This is primarily due to thin-film transistor (TFT) backplanes which, unlike their CMOS counterparts, lack the local amplification necessary to maintain a high signal-to-noise ratio.

## TECHNOLOGY DESCRIPTION

To help address these challenges in comprehensive radiation detection, researchers at UC Santa Cruz (UCSC) have developed a scalable imaging sensor platform. Unlike traditional detectors that require separate systems for different spectral ranges, the UCSC research results feature a modular array of active pixels engineered for concurrent [switchable] detection of ionizing and non-ionizing radiation. This design integrates a local integrated readout circuit monolithically on a substrate, housing an internal photodetector within every pixel. A sensing layer made of chalcogenide or semiconductor crystal material is deposited in a vertical stack directly over the readout circuit and electrically coupled through a conductive contact. This architecture presents a progressive technical departure from conventional flat-panel detectors by utilizing the sensing layer as both a primary high-energy converter and a transparency window. Consequently, while the top layer captures high-energy photons, low-energy photons pass through the top layer and captured by an underlying photodetector. This dual-mode and vertical integration enables high-resolution, low-noise imaging across a modular, stitchable surface area [sensor “tiles”] that maintains signal integrity better than the legacy thin-film transistor backplanes used today.

## APPLICATIONS

- medical imaging
- non-destructive testing
- security screening
- research tooling

## FEATURES/BENEFITS

- Features modular sensor tiles with stitchable areas which allows for scalable detection area to without negative SNR.
- Integrates micron-scale active pixels directly with a-Se sensing layers eliminates blurring common to scintillator-based devices.
- Dual-mode integrated circuit readout enables single hardware to perform both X-ray and VisNIR imaging.
- Monolithic CMOS architecture supports video frame rates and real-time reconstruction.

## INTELLECTUAL PROPERTY INFORMATION

Patent Pending

## RELATED MATERIALS

## CONTACT

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## INVENTORS

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## OTHER INFORMATION

**KEYWORDS**

amorphous selenium, a-Se, aSe, ionizing radiation, direct conversion, scintillator, active pixel sensor, APS, photodiode, stitching, CMOS, non-ionizing radiation, halide perovskite, radiation detection, radiation, Complementary Metal-Oxide-Semiconductor, medical imaging, non-destructive testing, security screening, thin-film transistor, TFT, spectral range, spectral

**CATEGORIZED AS**

- **Imaging**
  - Medical
- **Medical**
  - Imaging
  - Research Tools
  - Software
- **Security and Defense**
  - Screening/Imaging
- **Sensors & Instrumentation**
  - Medical
  - Scientific/Research

**RELATED CASES**

2025-943-0

## ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Systems and Methods for Identifying Anomalous Nuclear Radioactive Sources

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