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Label-Free Long-Duration Imaging of Cancer Spheroids Using Electrochemiluminescence

Label-free ECL imaging enables hours-long, non-destructive visualization of cancer spheroids for drug screening and tumor biology—no fluorescent tags, no phototoxicity.

Current imaging of 3D tumor models in oncology research is hampered by the need for fluorescent labels, which cause phototoxicity, disrupt cellular function, and limit observation time, or by destructive sample preparation that prevents real-time analysis. This technology introduces a new, label-free method for long-duration imaging of cancer spheroids. The innovation enables sustained ECL emission for over three hours and sharper spatial resolution, eliminating the need for exogenous fluorescent tags and avoiding phototoxicity. Compared to fluorescence microscopy and mass spectrometry, this approach allows >3× longer imaging, preserves sample integrity, and integrates with standard electrochemical and imaging equipment. The technology is at TRL 3–4, with proof-of-concept demonstrated in lab-scale breast cancer spheroids and sustained ECL emission validated. If adopted, this method could streamline drug screening and tumor biology studies by enabling continuous, non-destructive imaging in physiologically relevant 3D models, benefiting pharma R&D, CROs, and academic labs.

Technology Validation:

Proof-of-concept demonstrated with breast cancer spheroids: continuous imaging for >3 hours without phototoxicity, sustained ECL emission after potential is switched off (afterglow), and improved spatial resolution over luminol-based systems. Validation to date is in controlled lab settings.

Advantages:

Technology ID
2026-DICK-71377

Category
Materials Science & Nanotechnology/Advanced Functional Materials
Medtech & Digital Health/AI in Medical Imaging
Biotechnology & Life Sciences/Analytical & Diagnostics Instrumentation

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- Enables real-time, long-duration imaging (>3 hours) of 3D tumor models without fluorescent labels
- Reduces phototoxicity and preserves cellular integrity during imaging
- Integrates with existing electrochemical and imaging platforms (no major hardware changes)
- Provides sharper spatial resolution than prior ECL or fluorescence methods
- Uses commercially available reagents and standard lab equipment

Applications:

- Drug efficacy studies using long-term imaging of tumor spheroids
- Mechanistic cancer biology research without fluorescent labels
- High-resolution monitoring of metabolic activity in 3D cell cultures
- Toxicology and pharmacokinetics studies in spheroid models
- High-content screening for personalized medicine in pharma R&D

TRL: 3

Intellectual Property:

Provisional-Patent, 2025-09-24, United States

Keywords: label-free imaging, electrochemiluminescence, cancer spheroids, 3D cell culture, drug screening, phototoxicity reduction, tumor biology, high-content screening, live-cell imaging