PURDUE INNOVATES | Office of Technology Commercialization

Ingestible Capsule Tracks Coating Dissolution Inside the GI Tract

An ingestible wireless sensing capsule provides real-time, direct tracking of drug coating dissolution and location within the gastrointestinal tract to accelerate oral formulation development.

Pharmaceutical formulation teams lack a direct way to verify where and when oral dosage coatings dissolve under the complex conditions of a living gastrointestinal tract. This technology introduces an ingestible sensing platform that shifts evaluation from indirect imaging, systemic biomarkers, and laboratory dissolution baths to real-time, material-focused monitoring during gastrointestinal transit. Compared with conventional in vitro dissolution testing and physiology-focused smart capsules, the platform demonstrated direct tracking of coating-state changes together with gastrointestinal region localization, including an approximately 100-fold signal change during laboratory dissolution studies. An integrated prototype has been demonstrated in laboratory models, biologically derived gastrointestinal fluids, and a controlled porcine study, with sensor trends aligning with independent chemical measurements of segment-specific drug release. The approach is expected to help pharmaceutical developers identify formulation failures earlier, improve in vitro to in vivo correlation, and optimize targeted or controlled-release products with fewer indirect assumptions. Early beneficiaries include formulation scientists, coating suppliers, contract research organizations, and developers of ingestible diagnostic or drug-delivery systems.

Technology Validation

The integrated capsule was tested using controlled gastrointestinal models and biologically derived fluids, then evaluated in a porcine gastrointestinal model under guided placement. The system distinguished intact and dissolving coatings by their changing electrical response, localized events using environmental sensing, and showed agreement with independent chemical analysis of drug release without relying on imaging or downstream pharmacokinetic inference.

Advantages

Technology ID
2026-RAHI-71876

Category
Biotechnology & Life Sciences/Analytical & Diagnostic Instrumentation
Pharmaceuticals/Research Tools & Assays

Authors
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• Direct measurement: Monitors the material coating itself rather than inferring dissolution from imaging or systemic biomarkers.

• Spatial context: Associates coating changes with gastrointestinal regions to support site-specific formulation assessment.

• Real-time wireless readout: Enables continuous data collection during testing without tethered instrumentation.

• Formulation development value: Provides in vivo evidence that can complement standard dissolution testing and improve translational decisions.

• Platform potential: May be adapted to evaluate multiple classes of dissolvable, degradable, or responsive materials.

Applications

• Preclinical evaluation of enteric, delayed-release, and targeted oral drug formulations by pharmaceutical developers.

• Performance testing of pharmaceutical coating materials by polymer and excipient suppliers.

• Contract research services focused on in vivo dissolution and in vitro to in vivo correlation studies.

• Characterization of digestible or degradable food ingredients by nutrition and functional-food R&D teams.

• Expansion of ingestible sensing platforms by medical-device and gastrointestinal technology companies.

TRL: 5

Intellectual Property:

Provisional-Patent, 2026-07-23, United States

PURDUE INNOVATES | Office of Technology Commercialization

Roll-to-Roll Production of Smart Wound Dressings for Real-Time and Retrospective Monitoring

Scalable wound dressings with integrated pH, temp, and moisture sensors for real-time infection monitoring.

Researchers at Purdue University have developed a method to integrate colorimetric sensors into traditional wound dressings, leading to improved patient outcomes and streamlined care for both clinical and at-home use. Traditional wound care relies on passive dressings with manual inspections or lab analyses, while advanced options like hydrocolloid dressings or electronic sensors focus only on single parameters, such as moisture or temperature. These solutions, often expensive and limited in scalability, fail to address comprehensive monitoring needs. In contrast, the innovative smart dressings developed at Purdue enable real-time and retrospective monitoring of diverse wound conditions such as pH, temperature, and moisture levels, providing valuable insights for wound management. The scalable roll-to-roll production method is compatible with various commercially available fabric substrates, ensuring an adaptable, cost-effective solution for diverse medical and personal care applications.

Technology Validation:

In situ testing on a 14-day mouse wound model demonstrated the technology's ability to detect early signs of infection. The biocompatibility of the smart wound dressing was evaluated with a cell viability assay showing cell viability that remained above 80% throughout.

Advantages:

-Real-time and retrospective monitoring capabilities

-Indicate wound condition through measurements of pH, temperature, and moisture

-Compatible with various fabric substrates

Technology ID
2025-LEE-71004

Category
Medtech & Digital Health/Remote Patient Monitoring & Telehealth
Medtech & Digital Health/Wearable Health Tech & Biosensors

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View online

-Adaptable for medical and personal care uses

-Affordable

-User-friendly

-Enhance wound healing outcomes

-Reduced need for manual inspections

Applications:

Wound healing and monitoring in clinical and personal care settings.

TRL: 4

Intellectual Property:

Provisional-Patent, 2025-01-31, United States

Keywords: Biotechnology, Clinical Wound Management, Colorimetric Sensors, High-Throughput Manufacturing, Medical/Health, Point-of-Care Diagnostics, Real-Time Wound Monitoring, Retrospective Wound Analysis, Roll-to-Roll (R2R) Production, Scalable Medical Devices, Smart Wound Dressings

PURDUE INNOVATES | Office of Technology Commercialization

Wearable Epipen for AI based monitoring and administering for anaphylaxis

AI-powered wearable monitors anaphylaxis onset and auto-injects epinephrine instantly.

Researchers from Purdue University are developing an AI-powered wearable device designed to detect and treat anaphylaxis, a severe, potentially life-threatening allergic reaction that occurs rapidly after exposure to an allergen. This system integrates advanced sensors, AI-driven decision-making, and automated drug delivery to ensure rapid epinephrine administration. By using flexible CMOS electronics, microfluidics, and energy-efficient designs, the device aims to overcome current challenges surrounding current anaphylaxis treatment and other emerging wearables devices such as cost, comfort, accessibility, and timely intervention. The project also emphasizes manufacturability, security, and integration for scalability. The research team aims to push healthcare technology into the future of intelligent, autonomous systems.

Technology Validation:

The AI-powered wearable device for anaphylaxis was validated through sensor optimization, AI-driven decision-making, and automated drug delivery testing. Researchers tested microfluidic and spring-based injection systems, integrated power-efficient components, and ensured data security using encrypted communication networks. The system's functionality, reliability, and safety were assessed through real-world simulations, industry collaboration, and a figure-of-merit evaluation to optimize scalability and affordability.

Advantages:

-Multimodal monitoring

-AI-driven decision making

-Wearable and comfortable

-Energy efficient

Technology ID

2024-HUSS-70551

Category

Energy & Power Systems/Grid Modernization & Smart Grids
Computing/Networking & Connectivity
Artificial Intelligence & Machine Learning/Multimodal & Generative Visual AI

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View online

-Uses commercial-off-the-shelf components

-Modular design

Applications:

-Emergency anaphylaxis treatment

-Wearable or implantable AI-driven drug delivery systems

-Remote healthcare and telemedicine

-Pediatric and school-based allergy management

TRL: 2

Intellectual Property:

Provisional-Patent, 2025-01-24, United States

Keywords: Anaphylaxis Treatment, Biomedical Engineering, Electrical Engineering, Wearable Technology

PURDUE INNOVATES | Office of Technology Commercialization

Self-Calibrating Electro-chemical Sensors for Wearable/Implantable Sensors

Self-calibrating electrochemical sensors deliver accurate analyte readings in wearables, implants, water, and agriculture.

Researchers at Purdue University have developed self-calibrating electro-chemical sensors for wearable or implantable applications. While traditional electro-chemical sensors work well in laboratory conditions, they fall short in real-world applications where they face changing environments and cannot be regularly calibrated. Purdue's approach uses a sensor configuration that decouples environmental changes from the analyte measurements. This results in a sensor that is both more accurate and self-calibrating. Applications of this technology include uses in wearable/implantable technology, water monitoring and treatment, and agriculture.

Advantages

- Self-calibrating ion-selective sensors

- More accurate in real-world conditions

- Low cost

Applications

- Wearable/implantable technology

- Agricultural production

- Industrial production

- Water monitoring and treatment

- Pollution monitoring

Technology Validation:

This technology is in the concept stages and has been validated analytically with ML and signal modelling.

Technology ID
2021-ALAM-69324

Category
Computing/Internet of Things (IoT)
Agriculture, Nutrition, & AgTech/Ag Robotics & Automation
Medtech & Digital Health/Wearable Health Tech & Biosensors

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View online

TRL: 2

Intellectual Property:

Provisional-Patent, 2022-12-29, United States

Utility Patent, 2023-12-27, United States

Keywords: Electrochemical, implantable, Implantable Devices, Measurement, self-calibrating, sensing and measurements, sensor, wearable, Wearable Devices