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Rapid-Forming 3D Intestinal Crypt-Villus Hydrogel Platform for Drug and Disease Modeling

A bioactive 3D intestinal scaffold enabling rapid, physiologically relevant drug and disease modeling.

Pharmaceutical and biotech researchers face major limitations when using flat trans-well membranes, which fail to replicate the 3D crypt-villus topology that governs intestinal absorption, barrier function, and disease progression. This technology introduces a new class of bioactive hydrogel scaffolds that incorporate physiologically relevant architectural and biochemical cues to support extremely rapid formation of functional intestinal epithelium. Unlike typical systems requiring weeks of culture and producing non-physiological transport behavior, this platform demonstrates fast epithelial coverage and selective barrier performance consistent with native intestine. A lab-validated prototype has shown reliable epithelial formation and differentiated barrier responses in benchtop studies. The platform enables more accurate preclinical testing, improved disease modeling fidelity, and faster experimental turnaround for industrial users.

Technology Validation:

Validation was conducted using benchtop epithelialization studies and barrier assays demonstrating formation of functional monolayers and selective transport behavior. Additional studies confirmed barrier response to toxic challenges and performance differences across regions mimicking healthy and disease-like morphologies.

Advantages:

- Rapid formation of biomimetic intestinal epithelium compared to conventional inserts

- More physiologically relevant 3D structure for absorption and barrier assessment

- Compatible with common intestinal cell lines and streamlined for industry workflows

Technology ID

2025-LIN-71031

Category

Biotechnology & Life Sciences/Analytical & Diagnostics Instrumentation
Pharmaceuticals/Research Tools & Assays

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- Improved predictive value for drug transport and toxicity screening

- Supports integrated modeling of healthy and disease-like intestinal states

Applications:

- Preclinical drug absorption and permeability testing

- Gastrointestinal toxicity screening

- In vitro disease modeling including villus-atrophy conditions

- Bioprinting-enabled development of advanced intestinal models

- High-throughput screening requiring rapid epithelial formation

TRL: 4 – Validated lab-scale prototype with demonstrated functional barrier performance.

Intellectual Property:

Provisional-Gov. Funding, 2025-10-23, United States