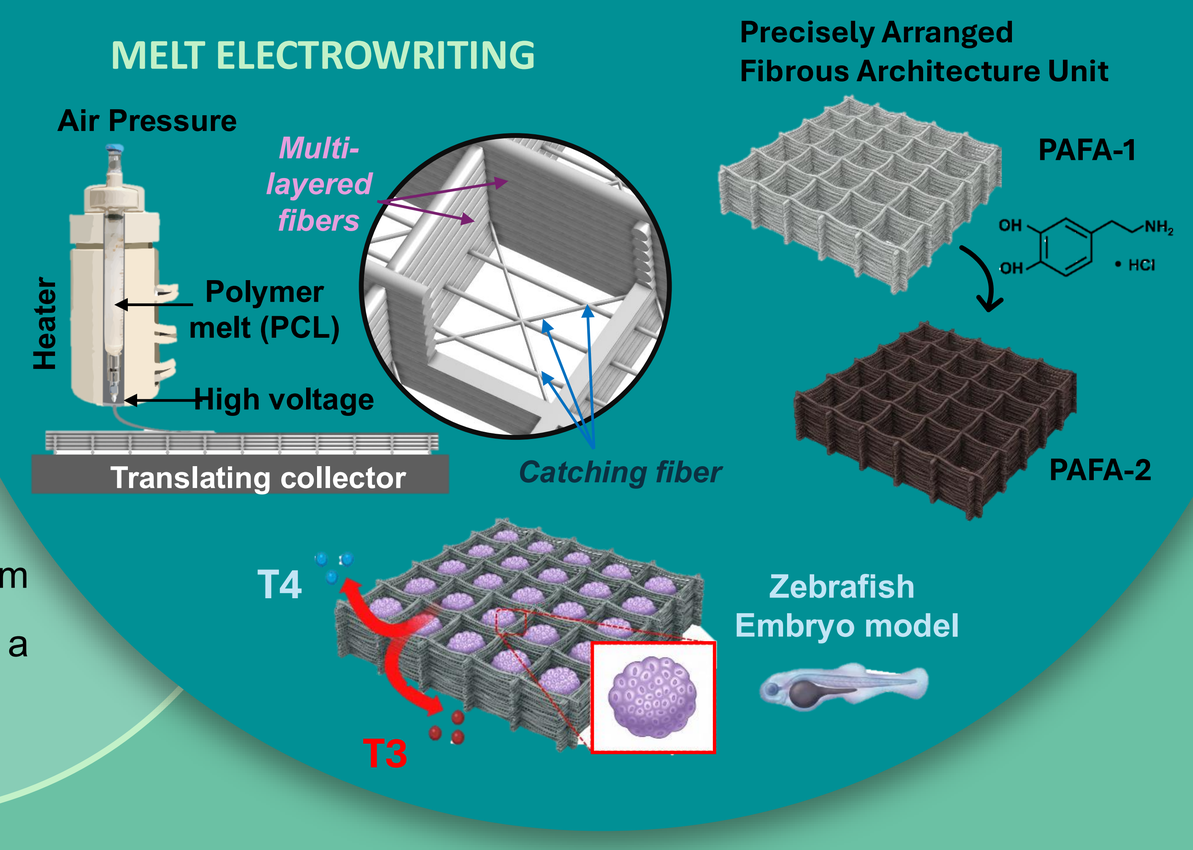
# A Biofabricated In Vitro Thyroid Culture Model Exhibiting In Vivo-Like Physiological Function Through a Precisely Arranged Fibrous Architecture

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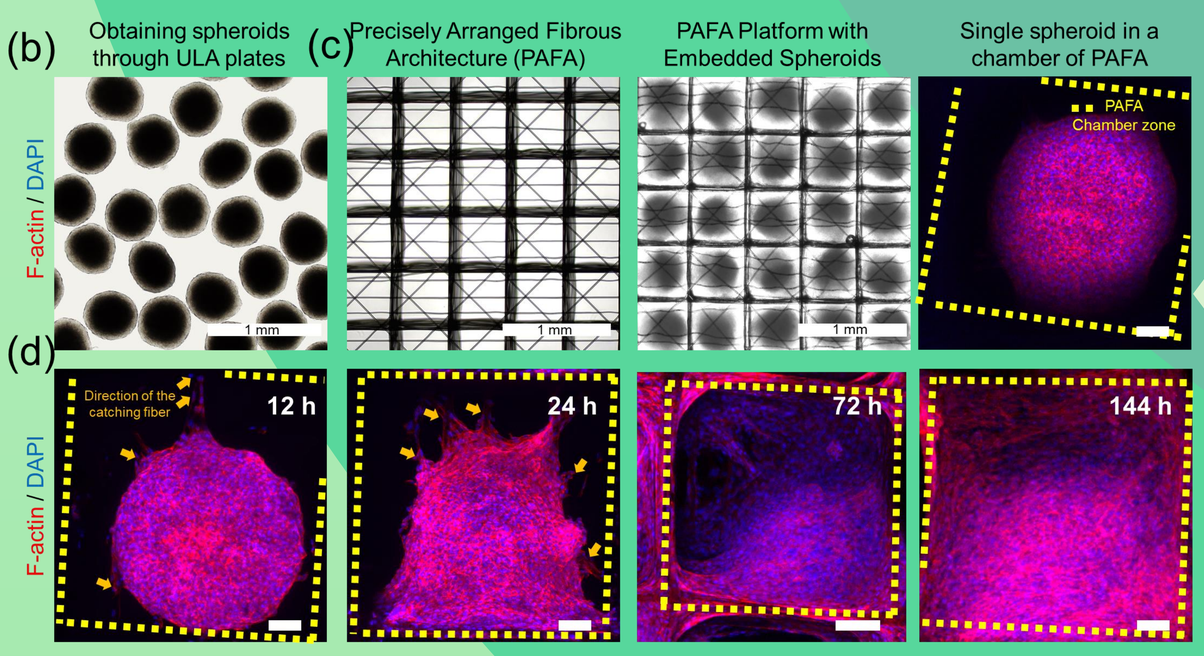
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Extensive research has been conducted to understand the effects of a wide range of chemicals on human health and the environment. In particular, **endocrine-disrupting chemicals** have gained attention due to their ability to interfere with hormone function. Therefore, the need for innovative assessment tools to provide reliable results in **identifying and regulating the risks** of potentially harmful substances. We propose this melt electrowriting enabled spheroid bioassembly platform to analyze how thyroid function is regulated. Our findings suggest that the PAFA platform provides a reliable in vitro model for regulating thyroid function, representing a significant step toward advanced **toxicity assessment tools**.



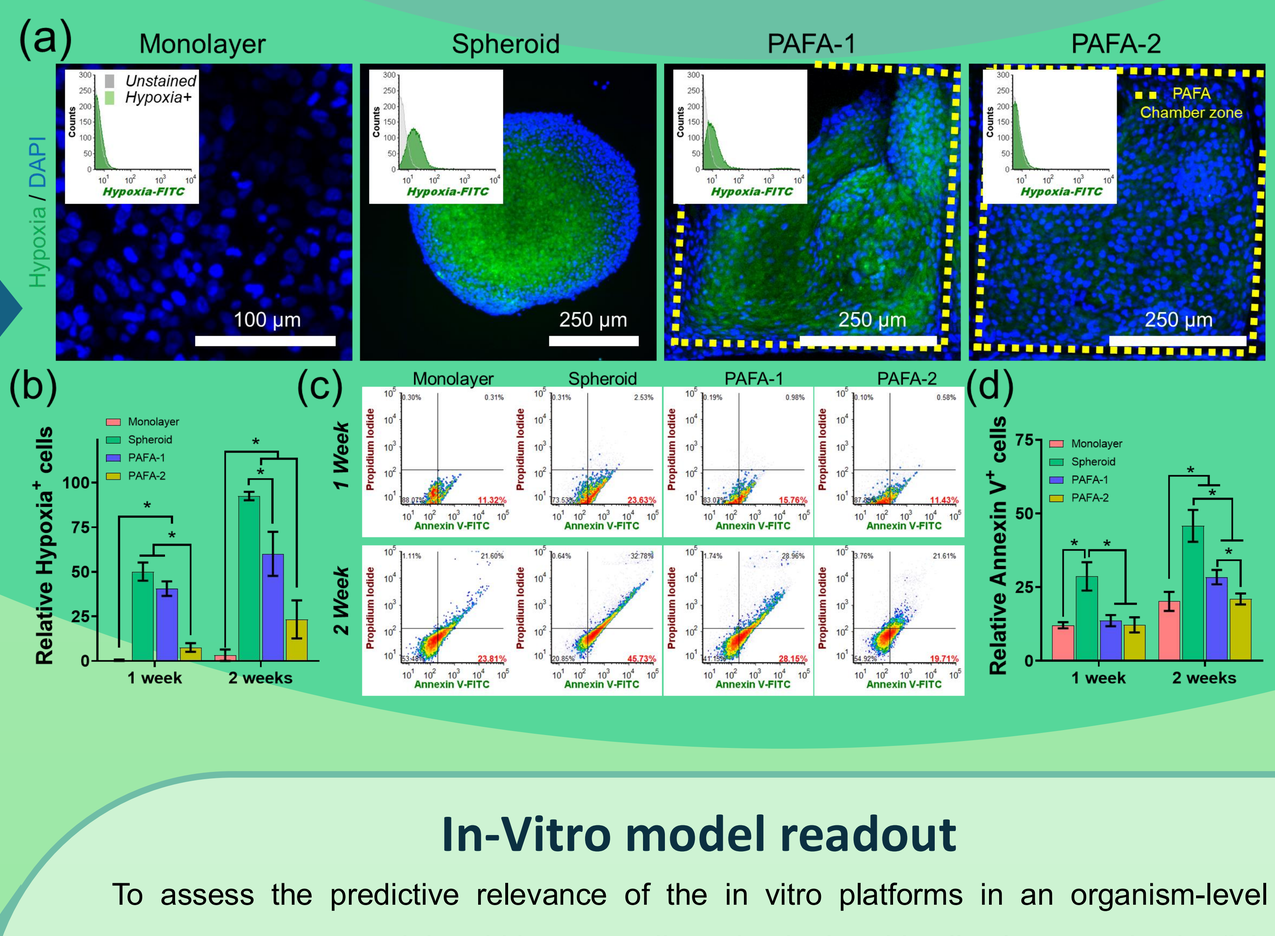

## Scaffold bioassembly

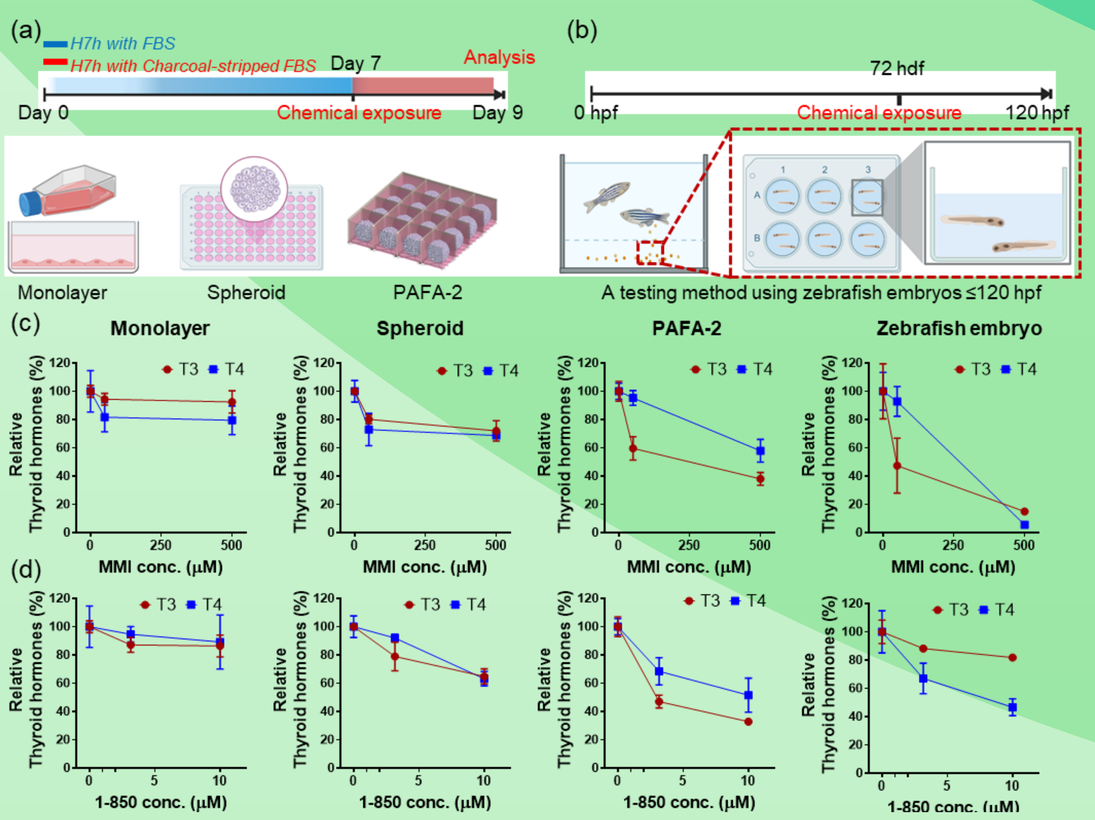
This study demonstrates that the PAFA platform provides a reliable and physiologically relevant ***in vitro* model** for thyroid **toxicity assessment**. PAFA is fabricated by melt electrowriting (MEW) to form a precisely arranged fibrous architecture that supports an ECM-like microenvironment and multi- spheroid cluster organization. The system is very versatile and scalable for different size spheroids. By matching dimension, occupation of only one box ensures an even distribution of cells in the tissue.




## Functionality assessment

PCL fibers are coated in polydopamine to make the fiber surface bioactive and increase cell attachment (PAFA-2). Compared with conventional monolayer and spheroid cultures, PAFA-2 specifically, shows **reduced hypoxia** and enhanced thyroid **functional outputs**, including thyroid hormone secretion and thyroid-related protein expression, and shows heightened sensitivity to thyroid-disrupting chemicals.




## In-Vitro model readout

To assess the predictive relevance of the in vitro platforms in an organism-level context, we compared thyroid hormone disruption in thyroid cell cultures and zebrafish embryos. Response trends of the PAFA-2 scaffolds are consistent with **zebrafish embryo** readouts. These results position MEW-enabled fibrous biofabrication as a **materials-driven** route to engineer functional endocrine models that help bridge the gap between conventional *in vitro* assays and organism-level benchmarks for toxicity assessment.

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