2022 全國兒童神經精神科學 勵翔獎 科學論壇
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Toward a Neurospheroid Niche Model: Optimizing Embedded 3D Bioprinting for Fabrication of Neurospheroid brain-like co-culture Constructs

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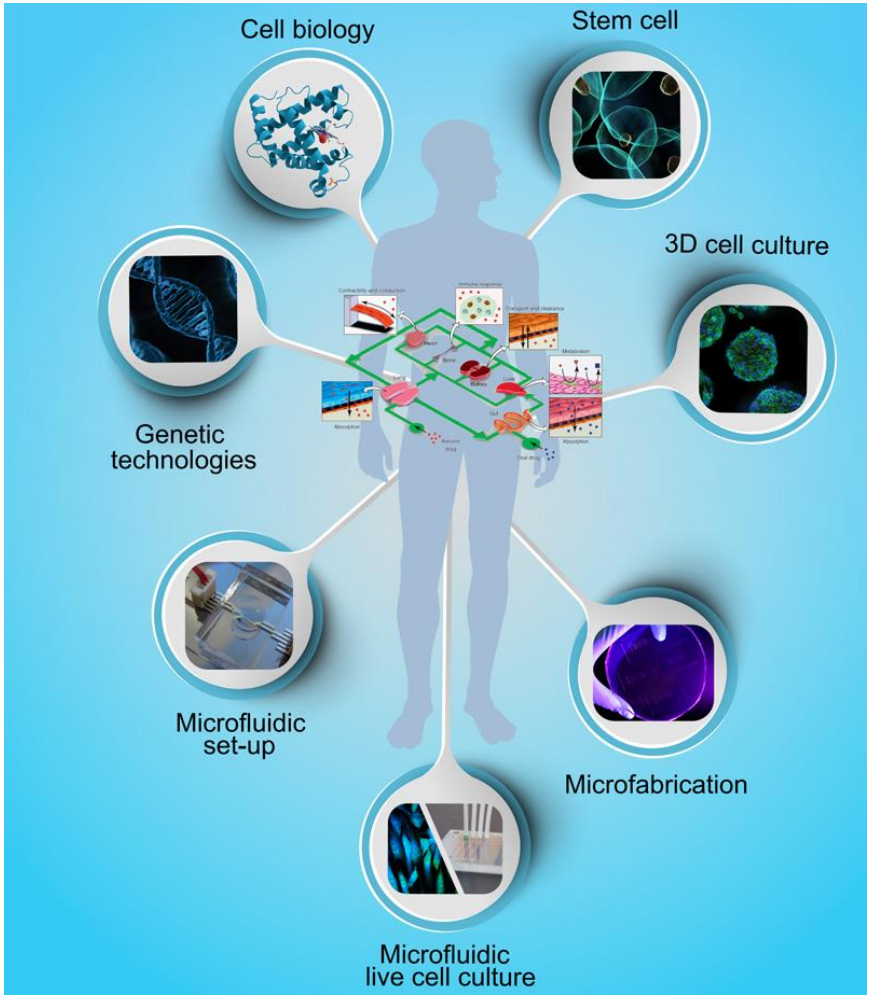
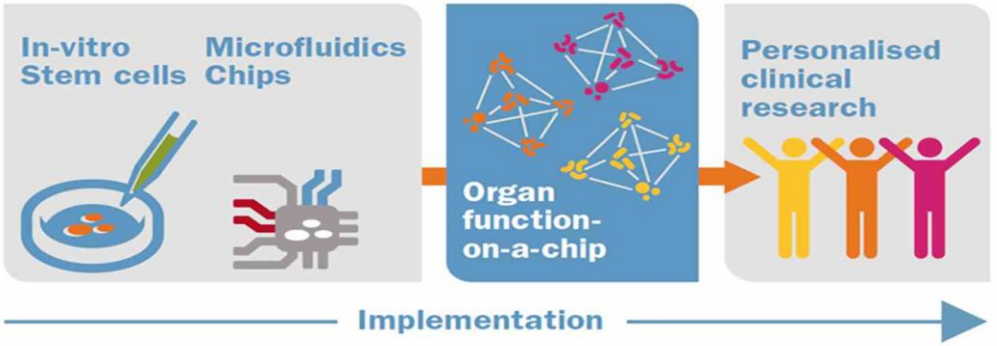
Microfluidic Organ-on-a-chip

The applications of Organ-on-a-chip





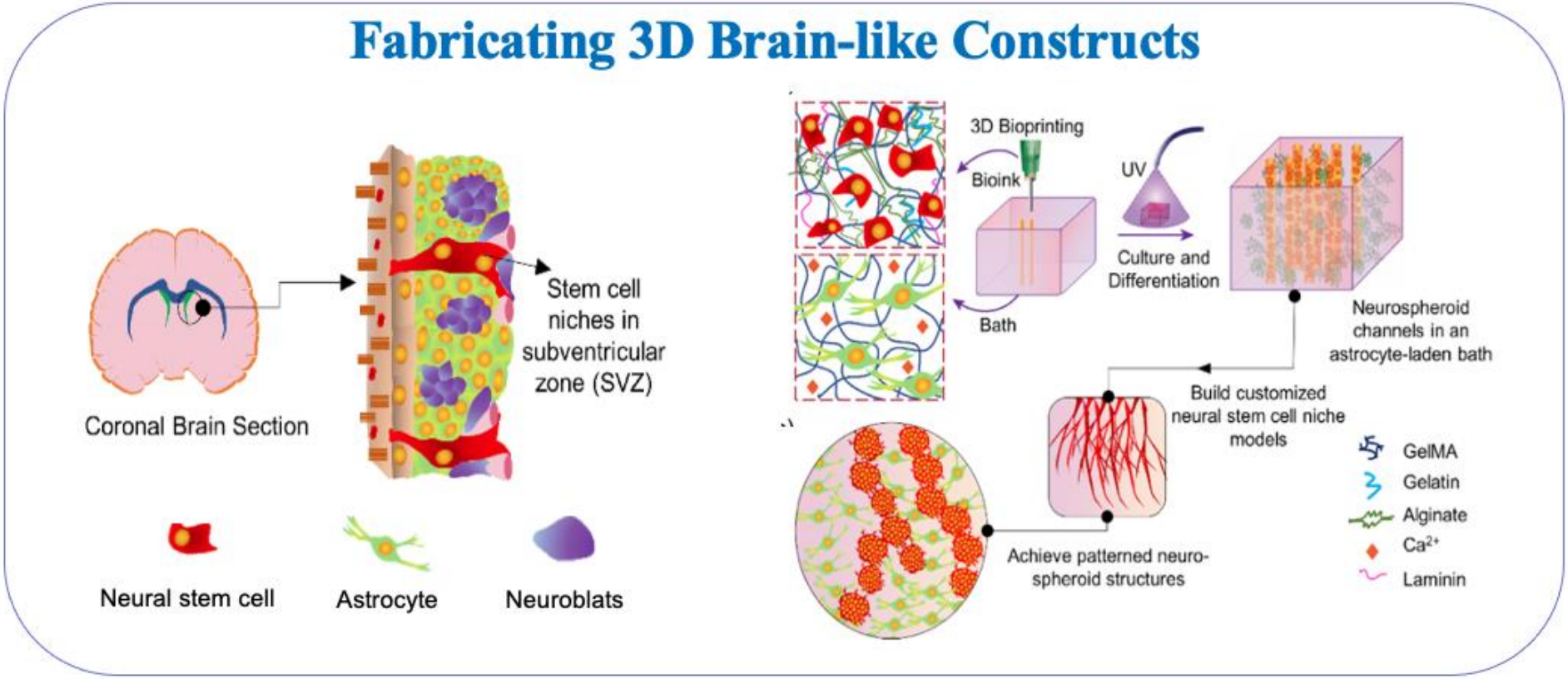
Advantages

- Fast-testing
- High-throughput
- Save money
- Stable
- Customization

- Achieve the goal of 3Rs for animal researches

Our Concept and Design

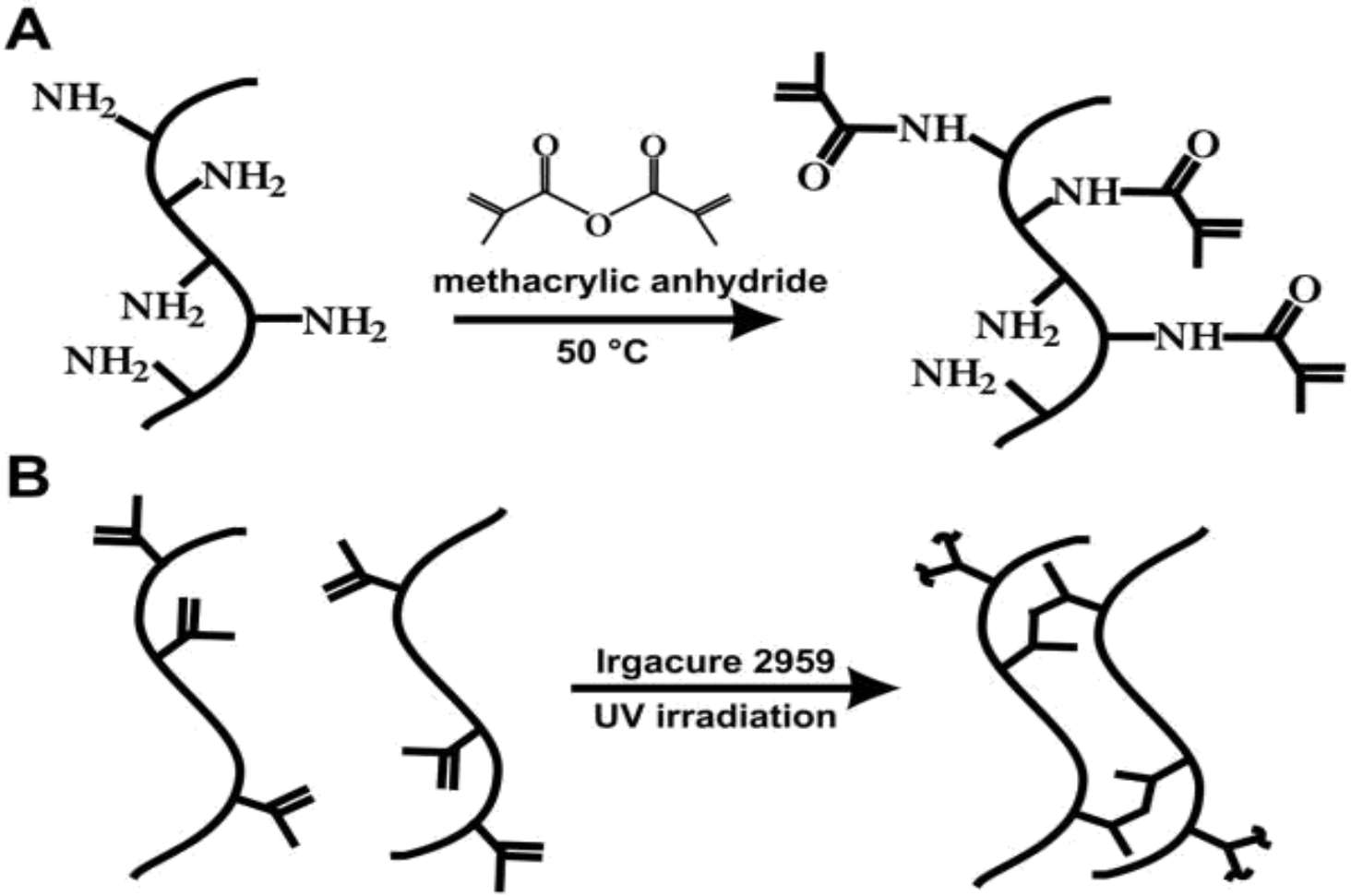
Concept: **Creating 3D tissue-like environments through 3D bioprinting technology**



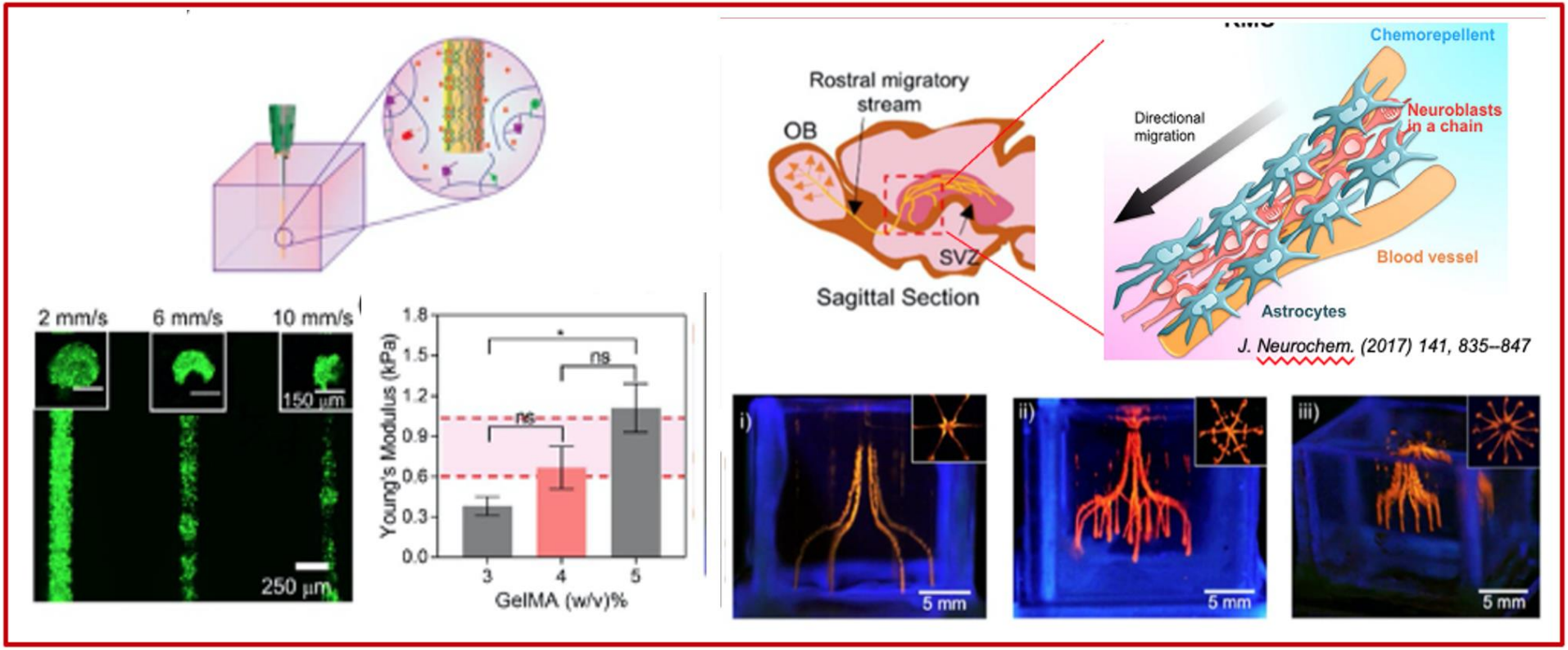
Purpose and Hypothesis

- **Optimizing the bioink and supporting bath to develop an *in vitro* 3D brain-like model**
- **The 3D bioprinting construct with a brain-like spatial structure could mimic the cell-cell interactions in a brain tissue**

The Synthesis of Gelatin Methacyloyl (GelMA) from gelatin

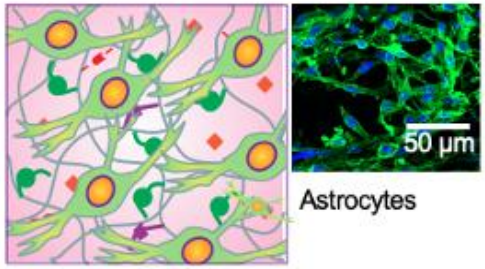


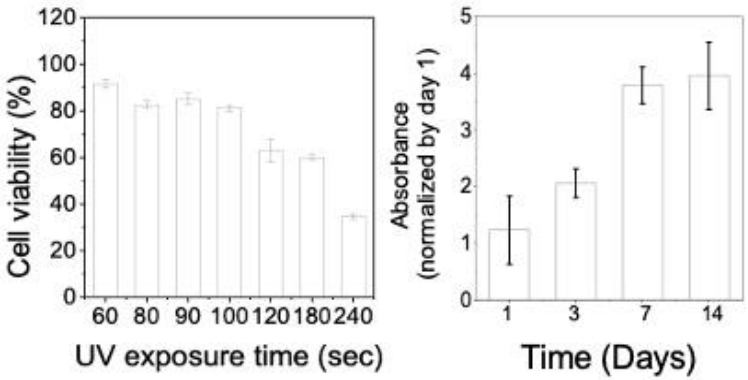
Identification of the Embedded 3D Bioprinting Neural-like Structure

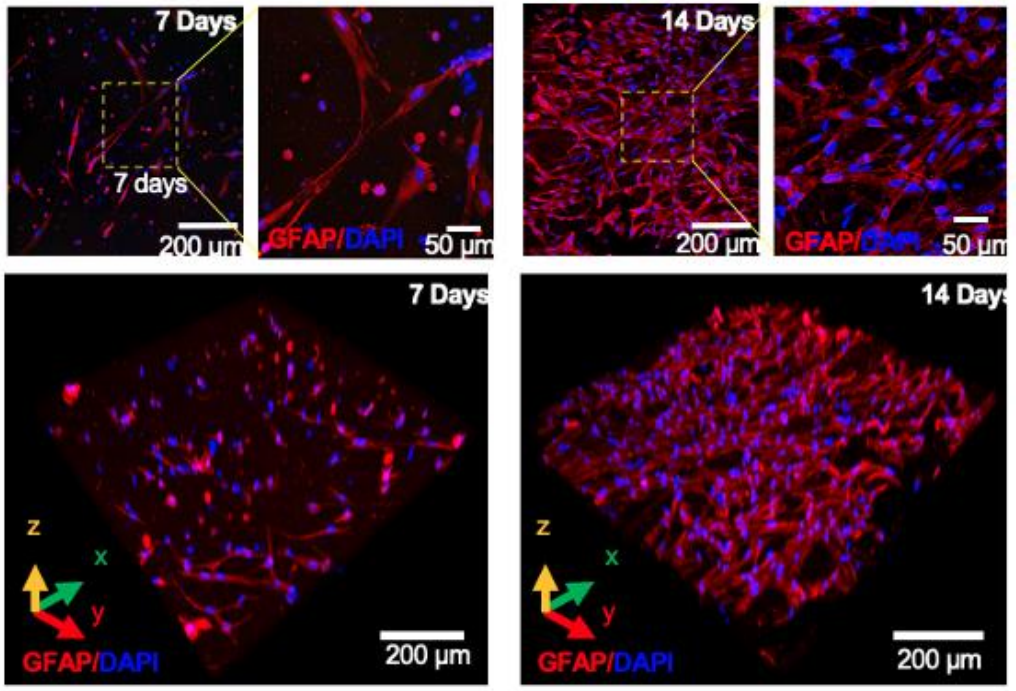


- The GelMA/alginate-based bioink possesses a printability for embedded bioprinting
- The diameter of printed fiber in supporting bath could be controlled by nozzle moving rate and extrusion rate.
- We could bioprint a free-standing rostral migratory stream (RMS)-like structure in a supporting bath

Cell behaviors of astrocytes in the GelMA supporting bath

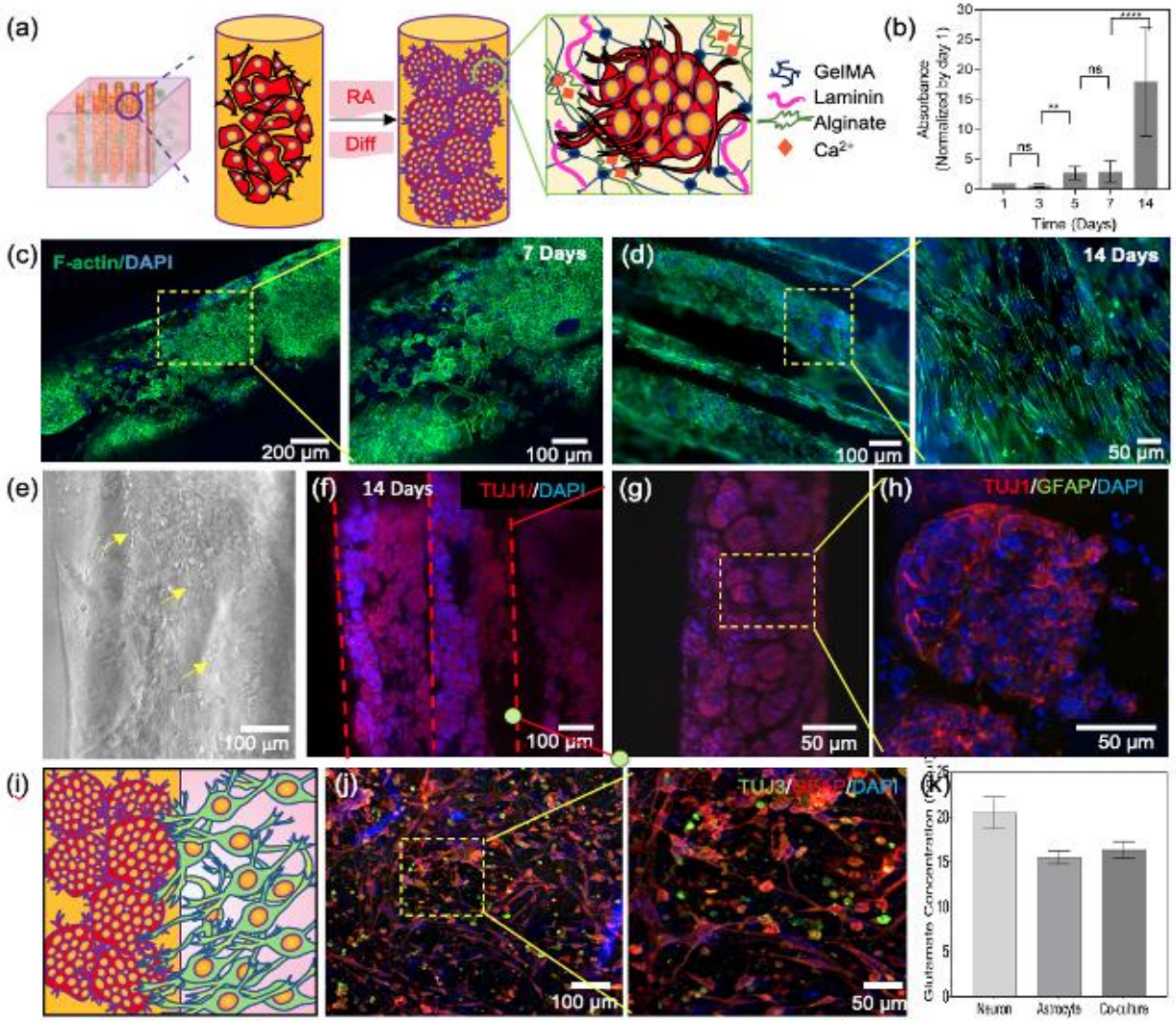






- **A primary brain astrocytes in the supporting bath still have high cell viability and proliferation ability after 60s of UV exposure**
- **After 14 days of incubation, astrocytes can extend and grow in the GelMA supporting bath**

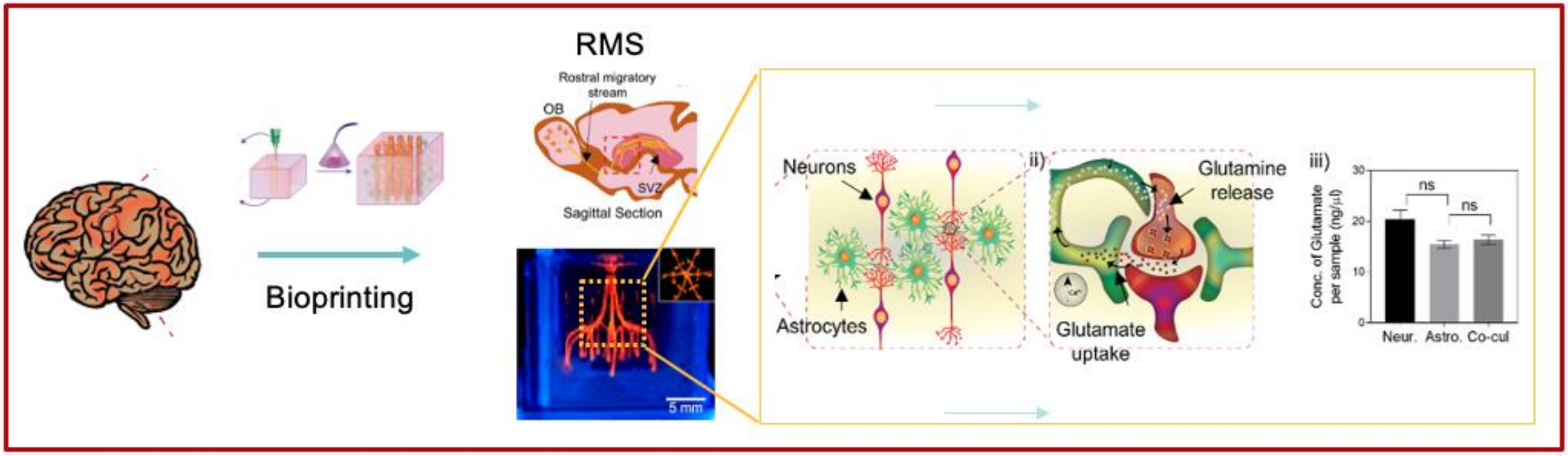
Co-culture of printed NSC-laden RMS in the astrocyte-laden supporting bath



- A neural stem cell (NSC) line, NE-4C cells, in the printed fiber maintain their metabolic activity and could differentiate into neuronal cells (TUJ1 expression) after 14 day of incubation.
- The low TUJ1 expression of cells around the printed fibers indicates that neurons could be conflicted in the printed RMS structures.

Summary

3D bioprinting a brain-like co-culture construct with the embedded NSC-laden fibers inside an astrocyte-laden supporting hydrogel



Aims

- **To optimize the cell-laden bioink and 3D bioprinting conditions for fabricating a 3D bioprinted construct**
- **To develop a 3D bioprinted brain-like construct that captures the 3D brain cellular configuration, the neuronal synapse function, and the neuron-astrocyte interaction**

Potential applications

- **Fabricating *in vitro* brain disease model such as Alzheimer's for drug testing or drug repurposing**
- **Providing a model for the researches in neural development field**

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