

PHYSICAL MECHANISMS OF CELL REARRANGEMENTS:
FROM TISSUE LIQUIDITY TO ARTIFICIAL ORGAN STRUCTURES

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ABSTRACT

This research presents a study of biological self-assembly in which we create 3D living functional tissue structures by exploiting the self organizing capacity of cells and tissues. Tissues composed of adhesive and motile cells mimic the behavior of viscoelastic liquids on both global and local scales. We exploited the concept of tissue liquidity to engineer tissue structures of relevant geometries encountered in the living organism. Embedding model tissue fragments in the form of spherical cell aggregates into biocompatible hydrogels, we demonstrated that by optimizing the cell-cell and cell-gel interactions, upon fusion long lived tissue structures emerge. We developed a rapid prototyping technique, “bioprinting”, and automated devices capable to produce standardized “bioink” particles in the form of cell aggregates. The tissues created with our bioprinter fused into biologically relevant geometries and showed functional characteristics. Our efforts represent an important step toward building complex organ modules via biological self-assembly.