

Folding Origami by Cell Forces

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This paper describes a method for producing micro-sized origami powered by cells. The cells can be powerful tools since they have several self-forces such as locomotion and traction forces for their migration. We use cell traction forces to produce 3D microstructure (Fig. 1). We seeded cells onto the development of the microplates on a glass substrate; these cells were adhered and stretched onto the plates. Immediately after detaching the plates from the substrate, the plates were lifted and folded up into three-dimensional (3D) structures due to the cell traction forces caused by stretched cells that adhered between two plates. It is like that the cells fold origami, so that we call this cell origami.

We achieved to produce 3D micro structures in various shapes such as cube, tetrahedron and dodecahedron using the 3T3 cells (fibroblast cells). Figure 2 shows the sequential images of the regular dodecahedron (cell ball). After detaching the plates from the glass substrate by using a micro-sized glass tube, the plates gradually folded and finally become a regular dodecahedron. We can also achieve more complicate structures by assembling several 3D structures. These results indicate that we are able to fold 3D micro structures using the cells. We believe that this method is useful for producing medical devices for minimum invasive surgery and developing tissue engineering.

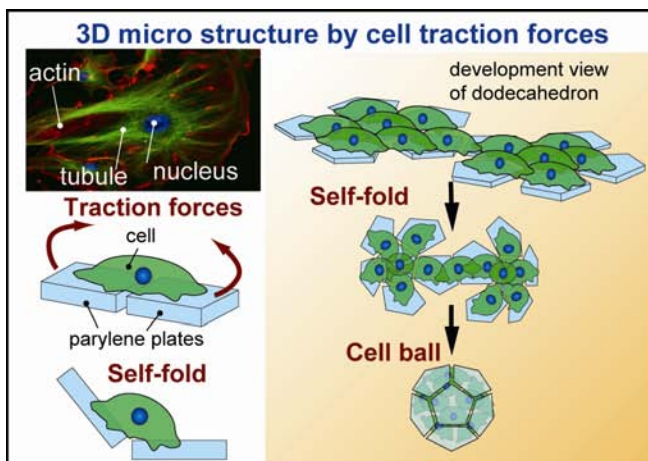


Fig. 1 Conceptual illustration of assembly of micro sized 3D structures powered by cell traction forces. Cells are cultured on patterned Parylene plates. Immediately after detached the plates from a glass substrate, a dodecahedron (cell ball) is folded by the cells.

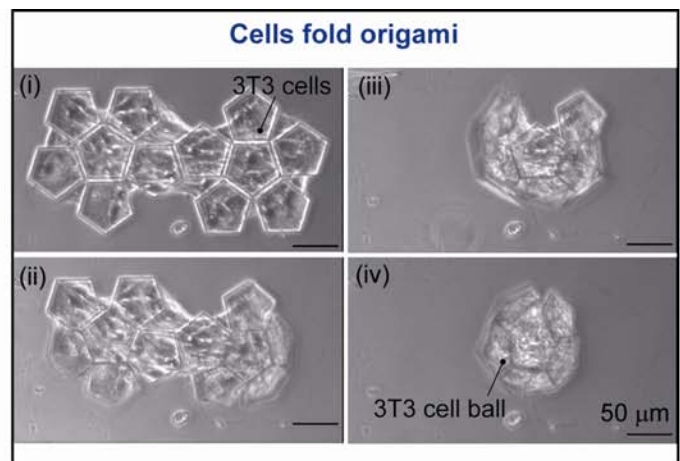


Fig. 2 Sequential images of folding 3D microstructures (cell ball) by the cells. Images were taken under a microscopy.