Cell Scaffold Materials Based on the Manipulation of Viscoelastic Properties of Polymer Gels

Keywords: Block Copolymers, RAFT Polymerization, ATRP, Gel, Ionic Liquid, Dynamic Cell Scaffold

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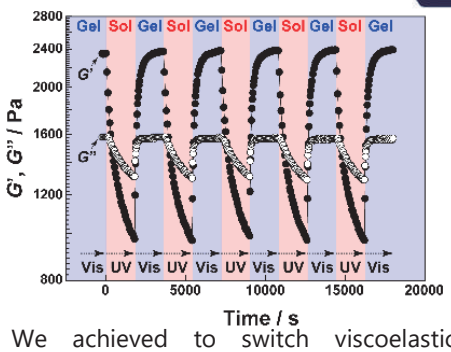
Background

- Not only physiochemical factors but also mechanical environment surrounding cells affects its behavior.
- Heterogeneous interface created in nm order governs absorption of proteins.
- It is undeveloped to control these two factors reversibly and independently.

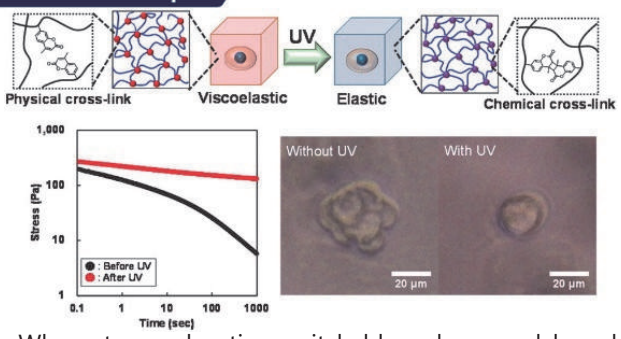
Aim

- Preparation of cell culture scaffold that can change mechanical environment surrounding cell such as viscoelastic properties, and stress relaxation ...etc., by utilizing reversible phase transition of polymers in liquid medium.
- Manipulation and accumulation of proteins using soft materials such as block copolymer and ionic liquid involving nano phase separation.

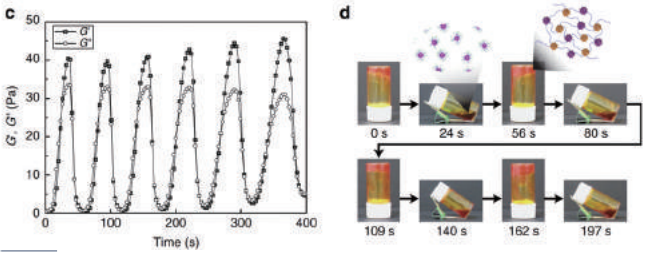
Advanced Research Topics



We achieved to switch viscoelastic properties of ionic liquid including nano heterogeneous structure, using an azobenzene containing block copolymer.



When stress relaxation switchable polymer gel based on dimerization of block copolymer was applied to three-dimensional cell culture, a change in cell behavior accompanying a spatiotemporal change in stress relaxation was observed.



We observed a polymer fluid that couples to a chemical oscillation reaction to autonomously change the viscoelasticity of liquid. Reversible change between gel and sol states without applying external stimulus can be seen.

Publications

- T. Ueki *et al., Angew. Chem. Int. Ed.*, **2015**, *5*, 3018.
- R. Tamate *et al., Chem. Mater.*, **2016**, *28*, 6401.
- M. Onoda *et al., Nature Commun.*, **2017**, *8*, 15862.

Summary

- We realized soft materials that can reversibly control the viscoelasticity of liquid by recombining the physical cross-links according to the physical- chemical-stimulus responsiveness of the block copolymers

Research outcome

- Construction of soft materials applicable under physiological conditions.
- Soft materialization of fluids containing nano heterogeneous structures.
- Development of a molecular system that gives cells a variety types of mechanical stress.