Micropatterned Thermoresponsive Surfaces via Physical Block Copolymer Coatings for Fabricating Cell Sheets with Designed Morphological Structures

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Introduction

A sheet-like cell manipulation using thermoresponsive poly(*N*-isopropylacrylamide) (PIPAAm)-immobilized culture surfaces has been developed for recovering the lost functions of tissues and organs [1]. Nowadays, we focus on the creation of bio-mimicking cell sheets in which heterogeneous co-culture system or aligned cellular structure, using micropatterned thermoresponsive surfaces (Figure 1) [2-4]. This study developed the facile method for fabricating micropatterned thermoresponsive surfaces via a two-step physically coating (spin-coating and subsequent microcontact printing (μCP)) of different thermoresponsive and amphiphilic block copolymers. Furthermore, we also investigated the effect of the difference in the amount of the amphiphilic copolymers transferred on the thermoresponsive surfaces on the morphological structures of the produced cell sheets.

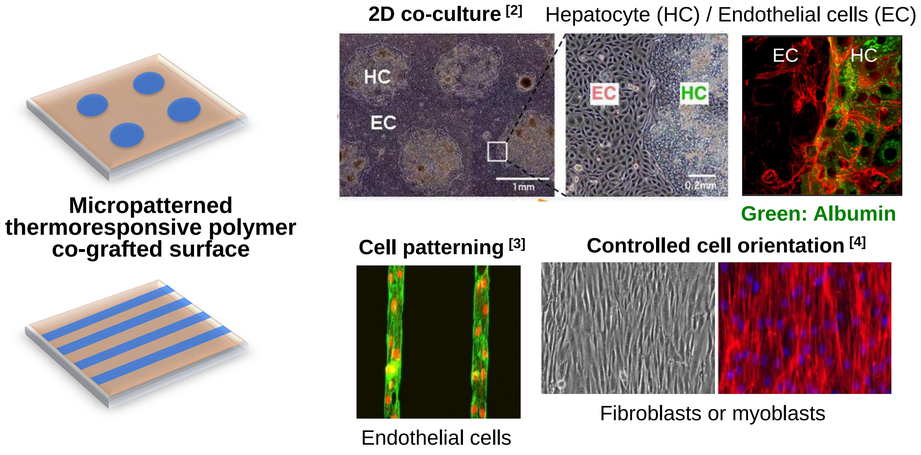

Figure 1 Micropatterned thermoresponsive surfaces for cell pattern, co-culture and bio-mimicking structures.

Summary

Micropatterned thermoresponsive/hydrophilic surfaces were prepared by microcontact printing of amphiphilic block copolymers onto the thermoresponsive block copolymer spin-coated surfaces. The properties of patterned surfaces were successfully varied by changing polymer concentration for contact printing. In addition, we investigated the effect of printed polymers on temperature-dependent cell adhesion. Using 50 μm stripe-patterned surfaces, the shape of cell sheet and/or cell alignment in sheet could be regulated by tuning the stamped polymer amount. Thus, this method would be useful for the facile preparation of micropatterned thermoresponsive surfaces to obtain functional cell sheets.

Acknowledgements

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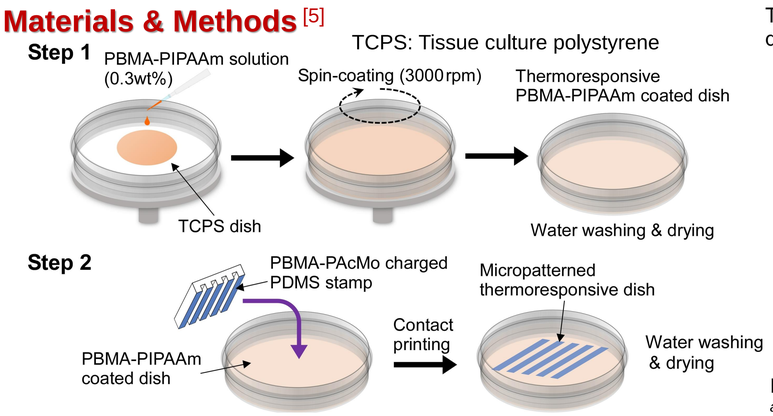
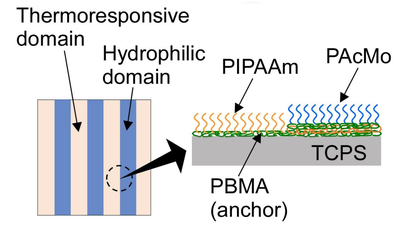
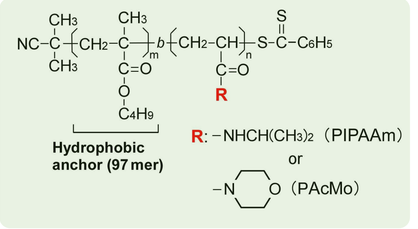
Materials & Methods [5]







Code	M_n (polydispersity) [a]	Degrees of polymerization [b]		
		BMA	IPAAm	AcMo
PBMA-PIPAAm	42000 (1.31)	97	251	−
PBMA-PAcMo	40500 (1.18)	97	−	188

BMA: butylmethacrylate, IPAAm: *N*-isopropylacrylamide, AcMo: *N*-acryloylmorpholine
[a] Determined by GPC. [b] Determined by ^{1}H-NMR.

Results and Discussion

Table 1 Characterization of polymer-coated surfaces.

PBMA-PAcMo concentration (wt%) for μCP	Amount of Polymer segments (PIPAAm or PAcMo) (μg/cm^2)		Static contact angle at 37°C (degree) [c]
	PIPAAm [a]	PAcMo [b]	
0*	0.99 ± 0.02	—	47.7 ± 1.6
0.5	—	0.52 ± 0.05	41.8 ± 0.9
1.0	—	1.12 ± 0.60	39.9 ± 0.9
1.5	—	2.41 ± 0.41	38.1 ± 0.8

[a] Determined by ATR/FT-IR using *PBMA-PIPAAm spin-coated TCPS (n=3).
[b] Determined by ATR/FT-IR using PBMA-PAcMo stamped TCPS (n=3).
[c] Determined by the captive bubble method (n=3).

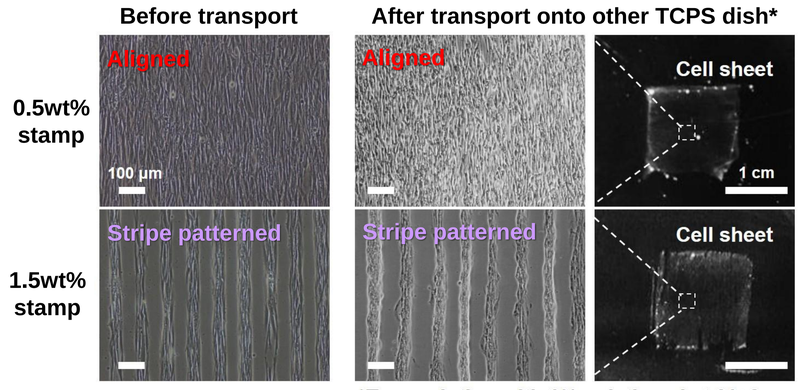


Figure 3 Cell sheet transport with maintaining the morphological structures.

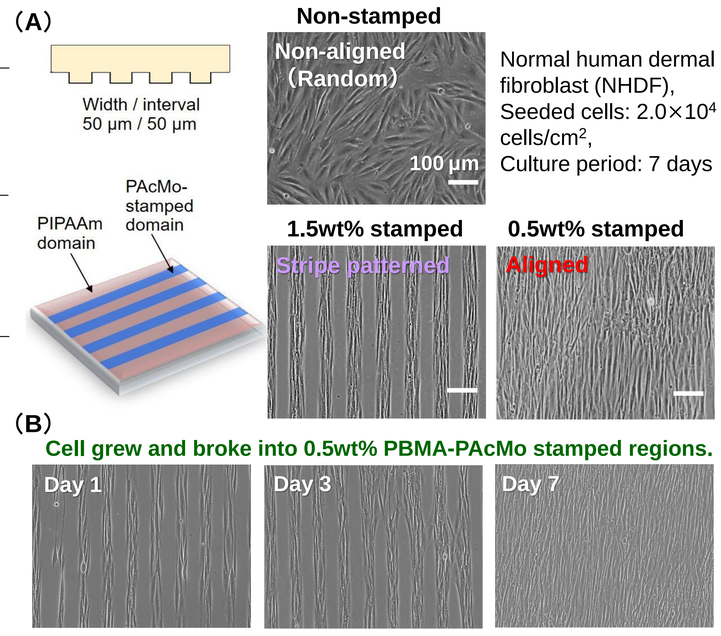


Figure 2 (A) Controlled cell adhesion on micropatterned PIPAAm/PAcMo domain surfaces and (B) time-dependent cell growth on 0.5wt% PBMA-PAcMo stamped surface.

References

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