**Biomimetic Stem Cell Niche Based on Block Copolymer Self-assembly**

**Lingfeng GUO**, Tomoko NAKAMOTO, Naoki KAWAZOE, Guoping CHEN*

International Center for Materials Nanoarchitectnics (MANA), National Institute for Materials Science (NIMS), 1-1 Namiki, Tsukuba, Ibaraki 305-0044, Japan

GUO.Lingfeng@nims.go.jp, Guoping.CHEN@nims.go.jp

## Abstract

Stem cells have essentially current and future clinical applications and strong potential to revolutionize human tissue engineering, cell therapy and gene therapy. Interaction between stem cells and their microenvironments (so called “stem cell niches”) is of great importance for maintaining a functional cell state and differentiation fate. [1] The significance of nanoscale surface structures of biomaterials has been increasingly recognized as a crucial factor for stem cell functions and specific nanotopography can induce certain biochemical cues and drive stem cells into desired phenotype and genotype. [2]

Block copolymers (BCPs) are two or more chemically different polymer chains jointed at one end with a covalent bond (Fig.1 (a)). According to the mixing enthalpy and entropy, the dissimilar blocks tend to phase segregate into ordered arrays of nanodomains (nanophase separation) with tens of nanometers in size (Fig.1 (b) and (c)). In this study, we used the self-assembly effect of biocompatible diblock copolymers to produce nanostructures surfaces, aiming at mimic the native structural feature as well as mechanical properties for stem cell function regulation. Three types of nanopatterns were fabricated through nanophase separation of block copolymers in thin film systems (Fig.1 (d) to (f)). By changing the components BPCs, nanopatterns could be prepared with distinct hydrophilicity and stiffness. The geometry features of nanopatterns were modified though varying the substrate interaction or the ratio of each block in copolymer/homopolymer systems. The influence of surface nanostructures on stem cell functions will be further investigated.

## References

[1] C. J. Bettinger, Pure Appl. Chem., **81** (2009) 2183; D. H. Kim *et al*, Adv. Mater., **22** (2010) 4551.
[2] M. J. Dalby *et al.*, Nat. Mater., **6** (2007) 997; J. Jiang, *et al*, Adv. Healthc. Mater., **2** (2013) 25.

## Figures

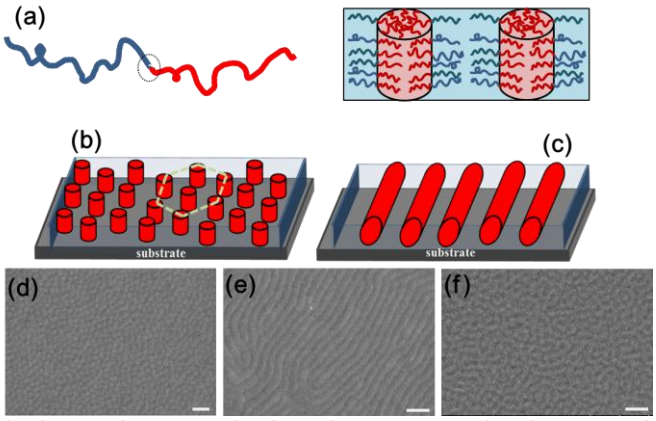


**Fig.1** (a) Structure of diblock copolymer and microphase separation in BCPs thin films; (b) structure of vertically oriented nano-rods and (c) horizontally oriented nano-cylinders in copolymer thin films; SEM image of nanopatterned surfaces (b) nano-spheres, (e)nano-stripes and (f) random nano-worms. Scale bar is 200nm.