Nano Petri dish having physically microsectioned-nanoengineered surface (PMS-NES) for regulating cell morphology and alignment

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Keywords: Nano Petri dish, Nanoengineered surface, Nano injection molding, cell morphology, cell alignment

The cell-nanotopography interactions have the ability to control cell behaviors including cell attachment, alignment, proliferation, and even differentiation due to physical stimulation of the nanotopography [1]. Many kinds of cell culture substrates with nanosurfaces have been developed by various nano-fabrication techniques such as lithography, self-assembly, polymer molding, electrospinning, and so on [2, 3]. Recently, we have developed a polystyrene nano Petri dish where nanopore array are patterned on the surface for cell-nanotopography interaction study by nano injection molding [4]. In this study, Nano Petri dish having a physically microsectioned ganengineered surface (PMS-NES) was newly developed for regulating cell morphology and alignment.

Figure 1 shows the schematic diagram of fabrication method for the nano-mold inserts (W-NES and PMS-NES). The nano-templates with whole nanoengineered surface (W-NES) and PMS-NES were prepared by the two step anodic aluminum oxide (AAO) process and the UV photolithography. Then, the nickel electroforming process was carried out for the metallic nano-mold insert. Figure 2 shows the (a) schematic design of the nano Petri dish and the schematic diagram of the nano injection molding process. The nano Petri dish have the bottom area of 30 mm × 30 mm and the NES of 20 mm × 20 mm on the center of the bottom surface. The polystyrene was selected as a molding material because it is mostly used material for cell culture wares (e.g. dishes, plates, and chambers). Figure 3 shows the SEM images of two different types of nano mold inserts with W-NES and PMS-NES. The nano-pillar structures are well formed on the surface of nickel nano mold inserts. Figure 4 shows the SEM images of Nano Petri dish’s surface having W-NES and PMS-NES. The nanopore arrays on the W-NES and PMS-NES were also well replicated by the nano injection molding process under the optimized condition [4].

As shown Fig. 5, the cells well attached and stretched on the W-NES and the PMS-NES compared to the flat surface. In particular, the stretched direction of cells on the PMS-NES was corresponded to the direction micro-line pattern (Fig. 5(c)). Figure 6 shows the immunofluorescent microscope images of cell cultured for 1, 3, and 6 days on the PMS-NES. The many cells attached on the nanopore arrays portion instead of flat portion as shown Fig. 6(a) and (b). At the 6 days, the cells proliferated on the outer nanopore arrays because there was no place to growth as shown Fig. 6(c).