Controlling Cell Adhesion on Photoresponsive Surfaces

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Functional substrates whose cell adhesiveness can be controlled by an external stimulus such as heat, voltage or light are promising chemical biological tools for fundamental cell biological studies, because cellular activities are highly affected by the interaction with their scaffolds as well as biomolecules dissolved in culture medium. We have recently reported a glass substrate immobilized with a silane coupling agent having a photocleavable protecting group. The substrate changed from non cell-adhesive to cell-adhesive in response to light. Its change in cell adhesiveness was based on the photochemical reaction-driven surface hydrophilization, resulting in illuminated region-selective substitution of fibronectin, a cell-adhesive protein, for a blocking agent that had been adsorbed to the surface via hydrophobic interaction. By controlling illuminating region, various cellular patterns including single cell arrays were available on the substrate surface. One of the most important features of this functional substrate is to form new cell-adhesive region during cell cultivation, because the photochemical reaction takes place in the culture medium. Taking advantage of this feature, we succeeded in co-culturing of multiple cell types and in induction of cell migration at the single cell level. In addition, we developed patterned illumination technology that allowed us to illuminate the substrate in arbitrary patterns under a standard fluorescence microscope. The present photoresponsive surface should be easily combined with advanced fluorescence imaging technologies to elucidate dynamic biochemical processes involved in cell-cell interactions and cell migration.