Control of Cell Surfaces Using LbL Films for Construction of 3D-Human Tissue Models

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Abstract: In vitro development of highly-organized three dimensional (3D)-engineered tissues consist of multiple types of cells and ECM, which possess a similar structure and function as natural tissues, is a key challenge for tissue engineering and pharmaceutical assay. Especially modulation of 3D-cell-cell interaction inside the 3D-artificial tissues is one of the significant issues.

We have developed a simple and unique bottom-up approach, “hierarchical cell manipulation”, using nanometer-sized Layer-by-Layer films consisting of fibronectin and gelatin (FN-G) as a nano-extracellular matrix (nano-ECM) [1-5]. The FN-G nanofilms were prepared directly on the cell surface, and we discovered that at least 6 nm thick FN-G films acted as a stable adhesive surface for adhesion of the second cell layer. We have also developed a rapid bottom-up approach, “cell-accumulation technique”, by a single cell coating using FN-G nanofilms, because the fabrication of two-layers (2L) was limitation through the above technique due to the time required for stable cell adhesion [6-9]. This rapid approach easily provided more than twenty-layered (over 150 µm) 3D-tissues after only one day of incubation. Moreover, fully and homogeneously vascularized tissues of 1 cm width and 100 µm height were obtained by a sandwich culture of the endothelial cells. The hierarchical cell manipulations will be promising to achieve one of the dreams of biomedical field, in vitro automatic creation of artificial 3D-tissue models [10]. We are demonstrating in vitro reconstruction of metastasis early processes, invasion, intravasation, mobilization and extravasation of human invasive carcinomas using artificial 3D-blood and lymphatic capillaries.

Biography: Michiya Matsusaki received his Ph.D. degree in 2003 (short period) under the direction of Prof. Mitsuru Akashi from Kagoshima University, Japan. After a JSPS postdoctoral fellow at Osaka University, he joined the Department of Applied Chemistry in the Graduate School of Engineering at Osaka University as a designated assistant professor. Since 2006, he has been an assistant professor of the department. He was a PRESTO researcher of JST as a concurrent position from 2008 to 2010. He is a Council member of Japanese Society for Biomaterials from 2012. He is also an Academic Editor of PLoS ONE Journal from 2013. He has received 12 awards and has published 84 international scientific papers, joined 5 book chapters, awarded 56 patents.