142bd Inverted Colloidal Crystals (Icc) Scaffolds as Three Dimensional Microenvironments to Study Cell Interactions in Co-Cultures

Jungwoo Lee, Sachin Shanbhag, and Nicholas A. Kotov

The highly ordered nature of Inverted Colloidal Crystal (ICC) matrices opens the possibility to accurately control 3D contacts of cells and processes induced by these contacts. In the past, only single cell-culture systems have been reported. In this work, we demonstrate a co-culture system made from suspension and adherent cells, which can serve as a model for the experimental investigation of cell contacts in various intercellular processes. As adherent cells, we used thymus epithelial Hs202.Th cells, while floating cells were represented by human premyelocytic leukemia HL-60 cells. A highly porous open architecture with 74% of empty space made it possible for the floating cells to travel deep inside the ICC scaffold. At the same time the ICC geometry, which is composed of close-packed spherical chambers of 100 μm diameter connected by smaller channels with diameters ranging from 25-30μm, has the capability to temporarily entrap floating cells, and thereby stimulate interaction of the floating cells with adherent cells coating the sides of the ICC chambers. From simplified Brownian Dynamics simulations, it was observed that a floating cell is in the vicinity of the scaffold surface or the adherent cells coating the scaffold more than 40% of the time. The transparency of the poly(acrylamid) hydrogel affords convenient observation of the co-culture system, which is revealed by confocal microscopy images taken up to 160μm inside the scaffolds. The well-known difficulty of hydrogel scaffolds to support adherent cells, in particular Hs202.Th cells, was mitigated by using a layer-by-layer coating of the scaffold wall with clay-polyelectrolyte multilayers. This method of coating of ICC scaffolds is expected to be applicable to other cell cultures consisting of a variety of tissue components.