

Stem Cells

Using BioFlux for propagation and differentiation of stem cells under shear flow

Introduction

Stem cell research has the potential to produce novel treatments for previously incurable diseases and injuries. The application of controlled shear flow to undifferentiated embryonic stem cells promotes enhanced expansion of cell lines (Fok, E. and Zandstra, P., 2005). Shear stress provides a stimulus for differentiation, particularly for cell types that naturally respond to physiological shear such as endothelial cells (Yamamoto et al 2003; Illi et al 2005; Wang et al 2005; Yamamoto et al 2005). Differentiation of cells into specific cell types and subsequent production of biomaterials is also facilitated by mechanical shear force. One example of this would be chondrocytes used to produce cartilage (Shuman et al 2006).

BioFlux Advantages

The BioFlux System (Figure 1) provides numerous advantages for stem cell applications. The ability to control shear flow in the vicinity of a stem cell sample enables physiologically-relevant conditions needed for propagation and differentiation experiments. Fluxion's Well Plate Microfluidic technology comprises micron-scale channels which utilizes substantially fewer cells and media than conventional culturing vessels. Each experimental channel can receive as low as 20uL of cell suspension or reagent. The stem cells can be imaged during or after application of shear flow or compound additions. Each BioFlux Plate has a #1.5 (180µm) cover glass bottom ideally suited for brightfield, phase, fluorescence and confocal imaging.

Representative Examples

Rat mesenchymal stem cells (Millipore) were grown in the BioFlux microfluidic flow channels (Figure 2). Channels were coated using either fibronectin or matrigel. Cells were cultured under shear flow conditions. This cell line can be differentiated into endothelial cells in the presence of shear flow. Cells were imaged in phase and epifluorescence (Nikon TS100). Nuclei were stained with Hoerscht 33342 (blue) and the contents of the endoplasmic reticulum, golgi and other membrane bound structures within the cell were labeled with wheat germ agglutinin (green).

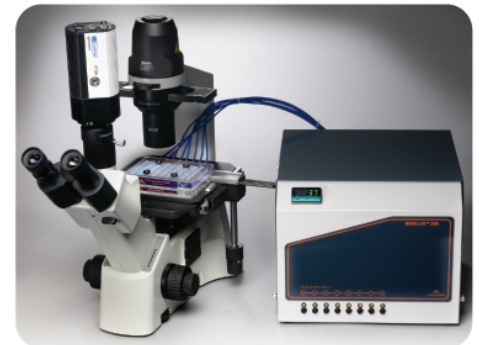


Figure 1: The BioFlux System for live cell assays under controlled shear flow.

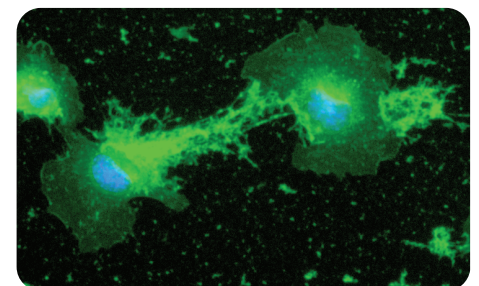
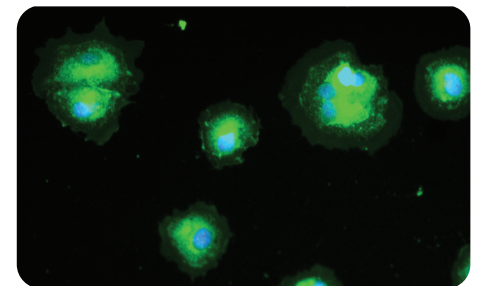


Figure 2: Rat mesenchymal stem cells grown under shear flow. Cells above were grown on a fibronectin coating. Cells below, shown during a cell division, were grown on matrigel.