

HIERARCHICAL NANOPOROUS LAYER (HNL) GLASS CHARACTERISTICS AND AN OVERVIEW OF CELL BEHAVIOR

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ABSTRACT

Adhesion at the interface between the artificial material and the living tissue is important when replacing tissues with artificial objects due to accidents, diseases, or other reasons. To get a beneficial tissue response, it is essential to study the interactions between living tissues and non-living materials to ensure it does not harm the patient. In recent years, Hierarchical Nanoporous layer (HNL) glass has been developed. The main characteristics of Hierarchical Nanoporous Layer (HNL) glass are, it has nanoscale pores and exhibits a long-life super-hydrophilicity, antifogging, antifouling, and low reflectivity. The unique characteristics of Hierarchical Nanoporous Layer (HNL) glass may help find new cell viability control perspectives. The wettability- hydrophilicity- of the material plays a significant role in cell adhesion and proliferation. The first step to take when biocompatibility evaluation is, wettability measurement. When cells adhere to a material's surface or biomaterial implant into an organism, the proteins will adsorb to its surface, allowing cell adhesion. Adhere cells will release active compounds allowing cell proliferation. From that, Protein adsorption is affected by wettability, causing cell adhesion. However, the roughness and Surface Charge is another vital parameter influencing cell adhesion. This study provides a general view of Hierarchical Nanoporous Layer (HNL) glass characteristics and an overview of adhering cells' behavior on its surface. Scanning Electron Microscopy was used to determine the surface's microstructure. Furthermore, the surface's roughness was measured using White Interference microscopes. X-Ray Photoelectron Spectroscopy was used to find the atomic concentration of the surface. The contact angle of the surface was measured with a contact angle meter to search for hydrophilicity. Furthermore, to get more information about the surface charge Zeta potential was measured. To evaluate cell behavior, cells were cultured, viability, adhesion, and proliferation were observed. The morphology of adhered cells was investigated by Scanning Electron Microscopy. The adherent cells were also stained and observed using a confocal laser scanning microscope. The results showed Hierarchical Nanoporous Layer (HNL) glass is formed with different pore sizes at the surface. The nanoscale detail causes roughness. It is a Superhydrophilic surface with a 4.5-degree contact angle. The atomic concentration is almost the same as Borosilicate glass (untreated glass). Hierarchical Nanoporous Layer (HNL) glass has a more negative charge compared to Borosilicate glass (untreated glass). The cells adhere to the surface of Hierarchical Nanoporous Layer (HNL) glass but spread slowly. Because Hierarchical Nanoporous Layer (HNL) glass is Superhydrophilic, lowering protein adsorption, the cell proliferation rate was lower. Also, since Hierarchical Nanoporous Layer (HNL) glass has more negative charge compared to Borosilicate glass (untreated glass) electrostatic forces might play a role in protein adsorption and cell adhesion. Cell behavior such as adhesion is not affected by just wettability. The other surface's physicochemical properties are deeply involved in the control of cell adhesion. Studying each surface property's influence on cells is difficult as it is difficult to isolate each independently.