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Title
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Authors
Monteiro, Othon R.
Bjornstad, Kathy A.
Brown, Ian

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Plasma deposited diamondlike carbon films for micro-patterning

Monteiro, OR 1, Bjornstad, KA 1 and Brown, IG 1
1 Lawrence Berkeley National Laboratory, Berkeley, CA USA

Abstract

Micro-patterning for cell culturing is a critical technique for today’s bioengineering that has gained increasing attention in recent years. Micro-patterning can be achieved by chemical or physical means. One important way of modifying the interaction between living cells and surfaces of materials conventionally used in biomedical applications is by means of thin coatings: of particular interest to this work is diamondlike carbon films (DLC).

Rather than a single material, DLC is best described as a class of materials, typically formed by carbon atoms or carbon and hydrogen atoms in a random network with no long-range order. The properties of these materials cover a broad range of values, and are primarily determined by their chemical composition and bonding configuration. Biocompatibility of DLC has been demonstrated in a series of publications 1-4.

DLC can be alloyed with other elements, such as refractory metals, Si, N, F and others. Adding these elements modifies both bulk and surface properties. Bulk properties, such as electrical properties or intrinsic stresses, have a great effect on the performance of the coated part under different operating conditions – eg external load, temperature and so forth. On the other hand, surface properties determine the interaction between the film and its environment, which is critical, for instance, for cell culturing.

An interesting application of DLC in micro-patterning has been recently proposed for the selective growth of neurons 5. Preferential attachment on DLC coated glass slides was demonstrated, as shown in Figure 1. However, cell growth takes place not directly over the deposited DLC, but on a layer of collagen, which lies between the modified surface and the cells. Therefore in order to understand the observation of preferential growth on DLC coated surfaces, it is important to understand the interaction between DLC and the collagen molecules.

Figure 1: Selective PC-12 neuron growth on collagen-coated, DLC plasma processed surface. The lower part of the micrograph was DLC coated. The unprocessed area experiences no cell growth 5.

In this article we discuss the deposition processes of the different types of DLC films on a variety of substrates, and some basic properties of such films. The effect of adding different alloying elements (N, Si, Ti) to the DLC on cell growth is discussed.

In this article we also discuss our experiments to test the hypothesis proposed in our earlier publication 5 that the selectivity in cell growth is actually due to differentiation in the collagen films prepared on the treated and untreated surfaces. Atomic force microscopy (AFM) and electron microscopy are used to characterize the collagen morphology on surfaces coated with the different types of DLC and surfaces without any DLC.

References: