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Investigating the Aqueous Swelling and Stability of Plasma Polymerised Acrylic Acid Films

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Plasma polymer films have been deposited on planar surfaces for a wide variety of applications, such as controlling cell growth or adding anchor molecules for biosensors. They can however also be deposited onto three dimensional objects, such as tissue engineering scaffolds, biomedical implants or 3D printed devices. Coating three-dimensional objects however is more complex as greater monomer fragmentation occurs closer to the electrode. It is therefore important to understand the properties of the plasma polymer films deposited at varying distances from the electrode. The use of plasma polymer films in biomedical applications also requires suitably stable films under physiological conditions, which will also be influenced by the distance from the electrode. Significant changes in film properties in aqueous conditions have serious implications on the incorporation of these films into a number of devices.

Acrylic acid is a commonly used monomer for plasma polymerisation to produce negatively charged carboxylic acid terminated surfaces, which have been used for a number of biomedical applications by manipulating cell growth. To gain a greater understanding of the spatially dependent behaviour of plasma polymerized acrylic acid (ppAAc) films deposited in our custom-built stainless steel T-shaped reactor, ppAAc films were deposited at varying distances from the electrode (3 – 19 cm) at different deposition powers (5 – 80 W). The surface chemistry was analysed with X-ray photoelectron spectroscopy while the film thickness was determined using spectroscopic ellipsometry. Film swelling of a selected group of samples was investigated with neutron reflectometry. Aqueous stability was investigated via immersion in Milli-Q and phosphate buffered saline. The film thicknesses and aqueous stability decreased while the carboxyl group concentrations increased as the distance from the electrode increased and/or the deposition power decreased due to reduced monomer fragmentation further from the electrode and at lower powers. For films deposited 11 cm from the electrode, complete film loss occurred at 20 W with film swelling at 30 W but no swelling at 40 W. This work highlights the importance of having a spatially well characterised plasma reactor to enable the deposition of plasma polymer films with the desired properties, which has significant implications on the incorporation of these films into a number of applications.

Speakers Gender

Female

Level of Expertise

Experienced Research

Do you wish to take part in the poster slam

No

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