Plasma deposition of thermo-responsive films of N-isopropylacrylamide using DBD at atmospheric pressure

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Thermo-responsive polymers are of great interest as functional coatings in biomedical applications. A widely used compound is poly-N-isopropylacrylamide (PNiPAAm) which switches its surface properties from hydrophilic to hydrophobic by passing the lower critical solution temperature (LCST) of 32 °C. PNiPAAm coated substrates can be used e.g., for controlled attachment and detachment of cells [1, 2].

In the literature, the deposition of PNiPAAm films by graft polymerization on activated substrates or by low pressure plasma polymerization has already been described [3-5]. In this paper plasma deposition of N-isopropylacrylamide on polypropylene foil was performed using a dielectric barrier discharge (DBD) at atmospheric pressure. High monomer retention, which is a precondition for thermo-responsive behavior, was achieved under pulsed plasma deposition with duty cycles $D = t_{on}/(t_{on}+t_{off})$ of D = 0.02 - 0.1. At room temperature a water contact angle $< 10^{\circ}$ was observed on plasma polymerized NiPAAm (pp-NiPAAm) films which rose to 25° for films deposited with D = 0.05 and D = 0.02, resp. While these films show measurable thermal response, the stability after storage in water was insufficient.

Film stability was improved by copolymerization with glycidyl methacrylate (GMA), leading to higher contact angles of the freshly prepared films. Due to cross-linking within the plasma polymerized film no sharp LCST, but a temperature range between 30 and 40 °C was observed (Fig. 1). The total increase of the water contact angle of a pp-NiPAAm-co-GMA film was typically about18°.

Future work has to be done to ensure long-term stability of these films, particularly in aqueous environment.



Figure 1: Water contact angle measurements of pp-NiPAAm-co-GMA in dependence on the different temperatures.

References

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