Plasma polymerization of N,N-dimethylacrylamide: cell-repellent or cell-adhesive coatings?

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Several precursors for plasma polymerization have been studied at length, including carboxylic acids, amines, siloxanes and ethers. This is in stark contrast with amide-based precursors, for which only a limited amount of studies are available [1-5], which notably differs with the abundance of biomedical research focussing on amide-based surface modification using wet chemistry [6-8]. This indicates that plasma polymerization of amide-based precursors has still unexplored potential, even more so because the previously performed chemical analyses were not extensive and the stability examinations were limited to only 3 hours of water incubation. Therefore, the plasma polymerization of a novel amide precursor (*N,N*-dimethylacrylamide) was explored in this study. The effects of varying discharge power on the plasma active species (OES), hydrophilicity (WCA), chemical composition (FT-IR, Raman spectroscopy, XPS) and stability (up to 1 week of water incubation, with AFM scratch tests) were examined. Additionally, the interactivity between cells (MC3T3) and the deposited coatings were studied in-vitro through life/dead fluorescent imaging and MTS assays. In contrast to the unstable coatings obtained at lower powers, the stable coatings showed a reduced preservation of the precursor structure and therefore a lower hydrophilicity. The plasma fragmentation resulted in coatings with a complex N-rich chemistry that could be directly linked to the observed plasma species. XPS C_{60} depth profiling indicated a difference between the top layer and bulk of the plasma polymer due to spontaneous oxidation and/or post-plasma deposition. Stable coatings were found to have cell-interactive behavior, showing a cell viability of up to 71% as compared to tissue culture plates after 1 day of cell culture.

[1]: Cheng et al., DOI:10.1021/la050417o. [2]: Chu et al., DOI:10.1016/j.surfcoat.2007.08.076.
[3]: Griesser et al., DOI:10.1163/156856294X00194. [4]: Pan et al., DOI:10.1021/bm0000642.
[5]: Bullet et al., DOI:10.1002/sia.2318. [6]: Morgese et al., DOI:10.1016/j.eurpolymj.2016.11.003.
[7]: Lin et al., DOI:10.1021/bm200368p. [8]: Liu et al., DOI:10.1021/bm201814p.

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