“Click & Seed” Approach to the Biomimetic Modification of Polymers

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Introduction

Functional surface modification of biomaterials for the cell adhesion is important not only for preparation of biodegradable scaffolds in tissue engineering, but also for model in vitro cell culture studies. To study the cell behaviour in response to surface chemical modification, the surfaces with suppressed adsorption of extracellular matrix proteins from the culture media are needed. A method of surface modification that could be simply applied to commercially available cell cultivation dishes was studied. The goal of the work was to create a protein-repulsive polyethyleneoxide layer on the polymer surface that would have a capacity to attach biomimetic ligands, e.g. ECM-derived peptides, using “click chemistry” approach in the next step.

Materials and Methods

Heterobifunctional polyethylene oxide (PEO) was purchased form Rapp-Polymere, Germany, cell cultivation dishes were purchased from Nunclon. The pentynoyl-PEO-NH-Boc was prepared by the reaction of the commercial Boc-NH-PEO-NH₂ with preactivated HOBT ester of the pentynoic acid. Deprotection of the Boc group was carried out in 95 % TFA and the product was dried under reduced pressure. Crude polymer was dissolved in 10 % Na₂CO₃, desalted by dialysis and freeze dried.

Cell culture dishes modification

Cell culture dishes consisted of three steps: 1) modification of the polymer surface with polydopamine¹, 2) grafting the PEO layer on the polydopamine surface and 3) “click-binding”² of the azidopeptide motif on the surface. Polydopamine interfacial layer was formed using a reaction protocol described previously¹; the grafting of PEO to polydopamine was performed by several methods (evaporation, melting under various temperature conditions) and compared. Cell adherence tests with modified surfaces were performed using mouse embryonic fibroblasts and NTERA-2 cell line cultivated in standard MEF medium.modification protocol.

Discussion and Conclusions

The grafting system was optimized for chemically and thermally defined conditions. The modification efficiency was significantly improved compared to previously published system¹ upon this optimization. PEO-grafted surfaces with the cell adhesion reduced to about 1 % of the values for standard cultivation plastics were obtained. The cell proliferation activity was significantly decreased as well. The presence of propargyl group on the non-adhesive surface was shown to allow for further modification by “click” of azide containing peptides.

References


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Disclosures

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