TWO-PHOTON INITIATOR DEVELOPMENT AND HYDROGEL NETWORKS BASED ON HYALURONIC ACID

Elise Zerobin[a,c], Maximilian Tromayer[a,c], Peter Gruber[b,c], Marica Markovic[b,c], Stefan Baudis[a,c], Jürgen Stampfl[b,c], Aleksandr Ovsianikov[b,c] and Robert Liska[a,c]

[a] Institute of Applied Synthetic Chemistry
[b] Institute of Materials Science and Technology
TU Wien, Getreidemarkt 9/163, A - 1060 Vienna
[c] Austrian Cluster for Tissue Regeneration

The use of biopolymers within hydrogel matrices have recently received attention, especially for their application in tissue engineering (TE). Hyaluronic acid (HA) is a natural occurring polysaccharide, widespread in the connective tissue of the human body. This endogenous substance can be used to develop a modular system for biocompatible hydrogel matrices based on different modifications of HA. Either, the primary alcohol can be modified via lately introduced vinyl ester (VE) functionalities to yield in polymerizable HAVE macromers,[2] or HA can be used as a macromolecular backbone material for the development of new two-photon initiators (2PI). VE modifications based on HA already showed increased biocompatibility compared to potential cytotoxic state of the art monomers, such as acrylates and methacrylates.[1] Cell compatibility is not only required for hydrogel precursors, like HAVE, but also for photoinitiators (PIs), especially when hydrogels are used as artificial tissue for regenerative medicine. Hence, a new water-soluble 2PI was developed within our research group.[3] The covalent attachment of 2PI onto HA increases the molecular weight of the 2PI molecules and therefore reduces its migration into cell membranes and consequently the cytotoxicity. Systems based on HA were tested for their cell compatibility after two-photon polymerization (2PP) in the presence of living cells. Hydrogel constructs with very high resolution were fabricated with both modifications of HA. By the use of HA, an attractive concept was found to combine highly reactive functional groups with natural biopolymers resulting in new materials for hydrogel matrices with advanced cell compatibility.

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[1] Heller, C., et al. (2009). “Vinyl esters: Low cytotoxicity monomers for the fabrication of biocompatible 3D scaffolds by lithography based additive manufacturing. Journal of Polymer Science Part A: Polymer Chemistry, 47(24): p. 6941-6954.

[2] Xiao-Hua Qin, et al. (2014), “Enzymatic synthesis of hyaluronic acid vinyl esters for two-photon microfabrication of biocompatible and biodegradable hydrogel constructs.

[3] Tromayer, M., et al. (2017). "A biocompatible macromolecular two-photon initiator based on hyaluronan." Polym. Chem. 8: 451-460.