Editorial corner – a personal view

Biohybrid polymers: novel options for regenerative therapies

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With the advent of regenerative therapies morphogenetic matrices polymeric materials capable of rekindling the cellular potential to regenerate tissues and organs evolve into a new paradigm of biomaterials research: Advanced therapeutic concepts require biodegradable cell scaffolds transmitting spatio-temporal sequences of signals to trigger cellular fate decisions. To this end, three-dimensional carrier structures have to provide fine-tuned physical characteristics and specific adhesion sites, the formation of chemokine gradients and the presentation of growth factors. So far, a vast majority of materials applied for that purpose is either based on reconstituted extracellular matrix biopolymers such as collagen I or on common biodegradable polymer (bio)materials such as polylactide. A wealth of technologies has been developed for the advanced processing of these materials.

To extend the resulting options biohybrid polymers – biopolymers covalently linked to synthetic polymers – receive more and more attention: A key feature of this emerging class of polymeric materials concerns the modulation of the specific signalling properties of the incorporated biomolecules. This may even allow for tuning of signal profiles of the bioactive scaffold structures beyond the characteristics of naturally occurring matrices – to switch cells into the ‘regeneration mode’. Another advantage of biohybrid polymers is related to their localized application via injection which is an important prerequisite of *in vivo* tissue engineering strategies. Based on these principles biohybrid polymers may

be expected to induce regeneration processes where we are missing them as urgently as in the injured heart muscle after myocardium infarction.

Successful examples of biohybrid polymers include polyethylene glycol (PEG) based networks with enzymatically cleavable peptide units to permit the ingrowth of cells ‘on demand’, i. e. in response to the local cellular activity or PEG-tethered transforming growth factor beta (TGF-*b*) to regulate smooth muscle cell function. Self assembling nanostructures of peptide-amphiphiles define another category of biohybrid materials with particular advantages for *in vivo* tissue engineering strategies.

The rapid progress in genetic engineering and synthesis of biomimetic peptide and carbohydrate structures will broaden the applicability of biohybrid polymers further and foster the merging of the strengths of molecular life science and ‘classical’ polymer science for the rational design bioactive materials. Progress of regenerative therapies is critically dependent on that.

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