Self-Reinforcing Polymers – A New Type Of Biomaterials

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INTRODUCTION

High performance polymers often have a narrow processing window, which is a crucial bottle neck in technology, including scaffolds for regenerative medicine. Unfavorable compromises between the processability and the final material properties must be made.[1] The physical interaction between the polymer chains of thermoplasts or thermosets are prerequisite for their high performance, however, also contribute to high solution or melt viscosity and low solubility. Hence, it has been desirable to develop a new class of polymers, which are easily processed and establish their high-performance properties in downstream processes ideally *in situ*. Self-reinforcing polyurethane ureas (srPUUs) are biocompatible polymers, which transform just by preconditioning them in aqueous media at body temperature and thereby forming polymers with increased strength, extensibility, and toughness.[2] This is achievable by including dynamic hindered urea bonds (HUBs) [3]; In water, these bonds transform to non-hindered urea bonds by a concerted sequence of chemical conversions.

METHODS

We systematically investigated the behavior of srPUUs by variation of components – macrodiol, isocyanate and HUB – and characterized properties before and after preconditioning. Polymers were synthesized by established prepolymer method.[4] Obtained polymers were solution-casted to films; Films were cut in half and either stored dry or in PBS solution. The mechanical properties and microstructure of films were compared by tensile testing and AFM, respectively.

RESULTS

Self-reinforcing was observed for polymers containing HUBs; An increase in tensile strength of polymer films of more than 100% was found. The effect can be tailored by amount and quality of HUBs. AFM indicates a consultation of hard segments during preconditioning, which is basis for self-reinforcing.

DISCUSSION& CONCLUSIONS

Self-reinforcing polymers are an interesting new concept and valuable complement to established polymers used for scaffolds in tissue regeneration. Still this class of polymeric materials needs further research to fully understand the underlying effects, enabling a rational design of tailor-made polymers for specific applications in tissue engineering and regenerative medicine. Currently, this new type of polymers are promising material candidates for electrospun vascular grafts.[4]

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