BIODEGRADABLE POLYMERS FOR BIOMEDICAL APPLICATIONS

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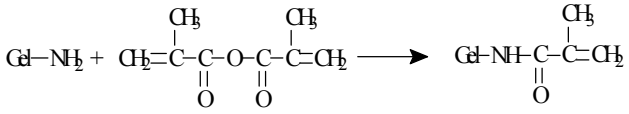
INTRODUCTION: Polymers are applied for a large number of medical applications : as medical supplies, as support or replacement of malfunctioning body parts or as a drug reservoir providing a local therapeutic effect. The specifications for the selected material strongly depend on the application. For temporary applications, biodegradable polymers may be the preferred candidate. In the past 3 decades, a large range of biodegradable polymers have been developed, tested and applied for a wide variety of medical applications. A recent development in biomaterial science is the use of polymers as scaffolds for tissue engineering and regenerative medicine. Biodegradable polymers are the preferred candidates for making such constructs. In addition there is the growing need to provide biodegradable polymers which also interact in a favourable way with the external biological environment as to stimulate cell ingrowth and tissue regeneration. This can be achieved by loading the scaffold with bioactive molecules or by surface modification of the scaffold.

BIODEGRADABLE HYDROGELS

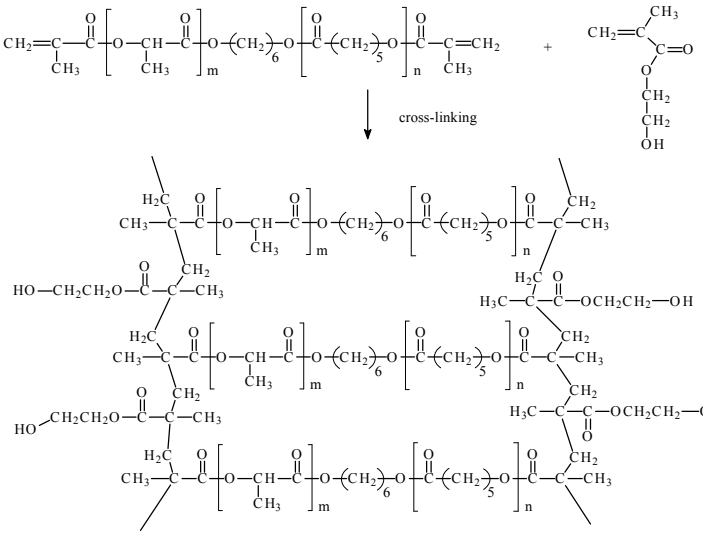
Hydrogels are interesting materials for medical application, including drug delivery systems and matrices for cell culture. As part of our biomaterials project we have developed biodegradable hydrogels either based on biopolymers or on poly(ethylene glycol) (PEG). In the first case the biopolymer, gelatine and/or agarose, was chemically modified in order to introduce polymerisable side groups (methacrylamide, methacrylate). Aqueous solutions of biopolymers can "solidify" by physical structuring and then be chemically crosslinked. The ratio physical crosslinkage/chemical crosslinkage can be controlled. Moreover, by means of simple cryogenic treatment phase separations can be achieved which lead to porous materials.



Biopolymer based hydrogels have been evaluated as materials for wound treatment. As an alternative, bismacromers of PEG containing well defined biodegradable segments were prepared and consequently crosslinked. The degradable segment is a depsipeptide consisting of one amino acid and either lactide or glycolide. By varying the depsipeptide composition, the rate of degradation of the hydrogel can be controlled. Such materials can be fine-tuned for a given application.

IN SITU CROSSLINKABLE BIODEGRADABLE POLYESTERS AND POLYORTHOESTERS

Starting from lactide, glycolide and/or caprolacton, and a diol as initiator, prepolymers with terminal HO-groups can be prepared. The latter can be easily converted into crosslinkable methacrylates.



By proper choice of the comonomers and the molecular weight of the prepolymer, viscous materials can be prepared which allow mixing with additives, such as porogens, calcium phosphates and biomolecules. Such mixtures can be applied into a bone cavity and then crosslinked, e.g. photochemically. The porogen is a water soluble particle which leaches out and creates pores of a given size. Such materials can be used for treatment of bone defects as well as for the fixation of metal implants, e.g. dental implants.

More details about the synthesis and properties of these biodegradable polymers and their biomedical application will be discussed in the presentation.