1. Aim of project

The aim of the project was to design a porous poly(organophosphazene) matrix suitable for tissue engineering. The increasing number of donor organs needed cannot be provided for anymore in this highly-developed era. Many patients are waiting for an allogenic transplant, thus for a young and healthy person to die. Even if the patient then receives the transplant, he/she has to take several drugs to suppress the immune system to avoid rejection of the organ. Additionally transplanted organs usually work properly for approximately 15 years only (depending on transplanted organ, age and general health situation).

Therefore tissue engineering is a future-oriented field combining skills from materials chemistry, biology and medicine. Several tissue types have already been studied like for example skin, blood vessels, nerves, bones, etc., but organs built from patient's cells on a scaffold are still a distant milestone. Several challenges need to be overcome first and this project was conducted to get a step closer to this goal.

In this project chemists, biologists and materials scientists worked together using poly(organophosphazenes) as a basis for the scaffolds. Currently used natural materials like collagene or fibrinogen suffer from drawbacks like limited mechanical strength and irreproducible matrices. Synthetic materials like the frequently used polyesters or polycaprolactone show, amongst other drawbacks, problematic degradation rates, acidic degradation products or insufficient biocompatibility. The poly(organophosphazene) backbone is known to degrade under physiological conditions releasing neutral degradation products. By the addition of proper side chains the properties and therewith the degradation rate of the polymer can be tailored to be attractive to cells. Crosslinking can be used additionally to obtain mechanical strength.

The task of the chemistry group was to develop a novel poly(organophosphazene), which fulfills all indispensable requirements. The polymer must be biocompatible and show a positive cell interaction. The cells should adhere to the scaffold, differentiate on it and invade it. To allow cell invasion and communication the scaffold has to show an interconnected porous structure. This porous structure on the one hand requires a certain mechanical stability to carry the cells without collapsing. On the other hand it has to degrade at a suitable rate, so that cells can build up their extracellular matrix, and release only non-toxic and pH neutral degradation products. Additionally, the matrices should be synthesized and purified in large amounts.

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