Abstract of the PhD Disertation by M.Sc Malwiny Niedźwiedź titled „Amphiphilic and hybrid polymer networks containing fibrinogen and catechol derivatives„

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In this doctoral dissertation, the synthesis of hybrid polymer networks and their components is described. It was assumed that by employing a hydrophobic component based on plant-derived fatty acids and a hydrophilic protein, the resulting hybrid polymer network would exhibit amphiphilic properties. Additionally, the influence of catechol on the adhesive properties of the polymer networks was investigated. In the experimental section, the synthesis of a telechelic macromonomer using various catalysts is described, followed by a comparison of their properties.

The experimental section describes the syntheses of a telechelic macromonmer using several catalyst and summarises their properties, as well as those of the polyurethane obtained on its basis. The selected macromonomer was subsequently used in further studies. A detailed kinetic analysis of the photocrosslinking process was conducted using two Type I photoinitiators, with an investigation into the effects of photoinitiator concentration, light intensity, and oxygen presence on the photopolymerization kinetics.

Through the application of a co-solvent method, hybrid polymer networks were obtained, including those with enhanced adhesive properties attributed to the incorporation of catechol. The amphiphilic nature of the resulting hybrid systems was confirmed through contact angle measurements using water and diiodomethane, employing the droplet deposition method. Furthermore, this analysis revealed surface reorganization phenomena within the polymer network structure. Differential scanning calorimetry (DSC) demonstrated glass transitions below room temperature, indicating excellent compatibility between the polymer network components.

The materials produced exhibited significant flexibility and low moduli, closely resembling the mechanical properties of soft tissues, which combined with the lack of cytotoxicity, indicates their potential suitability for soft tissue engineering applications. Furthermore, peel tests conducted on hydrophilic surfaces of catechol-containing films revealed a higher detachment force compared to polymers without catechol.

The hybrid polymer networks were subjected to protease treatment, and enzymatic degradation studies indicated that the inclusion of biological components, such as fibrinogen and catechol, accelerated the degradation process. Additionally, the protease expedited the degradation of polyurethane compared to its degradation in buffer alone.

keywords: biomaterials, amphiphilicity, polymer networks, photopolymerization

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