

TPS was prepared from mixture of natural cornstarch, water and glycerol or urea. Thermoplastic starch matter was prepared in four consecutive steps. Components were mixed at increased temperature and then dried, kneaded in Brabender at 130 °C and compression-molded. Two ways to blend preparation were tested and we examined the influence of the preparation process on the resulting material properties. In the first case, we prepared the plasticized starch by described procedure in the first step and subsequently mixed it with the polymer. In order to simplify the preparatory process, we used the second alternative, i.e. we added the dried starch mixture into the Brabender chamber in one step with the PBAT.

Compared to PBAT without starch, the values of tensile strength and elongation at break of starch-containing PBAT were lower and did not differ significantly regardless the amount of TPS present. The tensile strength values remain almost the same, except for the both samples containing 40 wt% of TPS plasticized by glycerol.

The values of elongation at break also drop down with addition of TPS and the decrease was more pronounced in the case of all samples containing 40 wt% of TPS. The decrease of tensile strength and simultaneous decrease of elongation at break can be justified by immiscibility on molecular level.

When comparing the two procedures of blends preparation the two-step mixing did not provide a significant improvement in mechanical properties.

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Hardness improvement and corrosion resistance examination of nitrided Ti-6Al-4V ELI biomedical material

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Keywords: nitriding, titanium alloy, Ti-6Al-4V, corrosion, surface modification

Titanium and titanium alloys are widely used in biomedical devices and components. Ti-6Al-4V ELI is mostly used for orthopaedic and spinal implants. This alloy has good biocompatibility, formability, machinability and corrosion resistance. However, its hardness and wear resistance can be improved. Therefore, surface modification is necessary and there are numerous surface engineering methods to enhance its tribological performance [1].

Nitriding is a thermochemical surface treatment which can improve the hardness and wear resistance of the surface. Nitrogen diffusion hardening creates $\text{TiN} + \text{Ti}_2\text{N} + \alpha\text{Ti(N)}$ in the top layer of the material and leads to an increased surface roughness [2], [3]. The cell viability after 5 days is also better on the nitrided titanium alloy, so the biocompatibility can be increased with the treatment [4]. However, the nitriding parameters for titanium are not well defined, and direct current plasma nitriding (DCPN) can cause irregularity on the surface.

In this experiment Ti-6Al-4V ELI disks were treated by various plasma nitriding methods (conventional plasma nitriding – DCPN and active screen plasma nitriding – ASPN) as well as gas-nitriding. Surface hardness was measured before and after nitriding. The treated samples were cut in half for cross section examination with scanning electron microscope. The corrosion rate of the material is determined by potentiodynamic measurements with a potentiostat. The final aim of the research project is to improve the properties of spinal screws and other implants with surface treatment for reaching better wear and corrosion resistance.

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The Formation of Tb doped TiO₂ thin films using thermal oxidation method

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In this study, Tb doped TiO₂ (Tb-TiO₂) thin films were deposited by RF and DC magnetron co-sputtering, which were formed using thermal oxidation. The effects of the constitution and annealing temperature on the characteristics of TiO₂ thin films were investigated. The crystalline structures, morphological features and photocatalytic activity of TiO₂ films were systematically studied by X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM) and ultraviolet spectrophotometer, respectively. Furthermore, photocatalytic activity of Tb-TiO₂ thin film was evaluated using degradation methylene blue aqueous solution. The Tb-TiO₂ film thickness was about 200 nm after annealing at 550 °C. The transmittance and hydrophobic of film can be significantly improved after annealing. There are only rutile phase in TiO₂ film with terbium addition. The degradation rate of methylene blue was 46.6% under UV-C light irradiation for 3 hours.