

## Surface treatment of polyetherketoneketone for load-bearing implants

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**INTRODUCTION:** Polyetherketoneketone (PEKK) is a promising biomaterial for load-bearing implants due to mechanical behaviour, radiolucency, MR-compatibility, and chemical inertness. For bone implants, however, PEKK surfaces have to be intentionally modified to allow for proper cell attachment. Plasma and ultra violet ozone (UVO) treatments are common processes to chemically activate polymer surfaces. The oxygen plasma treatment of PEKK films also results in well reproducible nanostructures, tailored adjusting plasma power and treatment time [1]. UVO surface treatments with 20 minutes duration are permissible for polymer micro-cantilevers [2, 3]. In this communication, we investigate the influence of the treatments on the chemical nature of PEKK.

**METHODS:** Commercially available 60  $\mu\text{m}$ -thick PEKK films (OXPEKK Permetta<sup>TM</sup>, Oxford Performance Materials, South Windsor, USA) were activated using the oxygen plasma treatment with the RIE System Plasmalab 80 Plus, Oxford Instruments, Abingdon, UK at a power of 10 W for a period of 5 minutes. The UVO treatment with the UV Clean Model 13550, Boekel Scientific, Feasterville PA, USA took 20 minutes. Changes of the surface chemistry were studied using reflection Fourier transform infrared spectroscopy (FT-IR). The spectra were recorded using a Centaurus IR-microscope coupled to a Nexus IR spectrometer (Thermo Electron Corporation, Thermo Fisher Scientific, Dreieich, Germany) with a grid of 300  $\mu\text{m} \times 300 \mu\text{m}$ .

**RESULTS:** Figure 1 demonstrates that the FT-IR spectra of the basic and plasma-treated PEEK films do not show significant differences. The spectra of UVO-treated films, however, differ from the basic material. One finds additional carbonyl groups present at a wavenumber of about 1700  $\text{cm}^{-1}$ . It should be noted that differential scanning calorimetry measurements showed no changes in thermal behaviour between the basic and the plasma-treated films. For the UVO-treated films, however, an increase of the glass transition temperature by 4 K was observed.

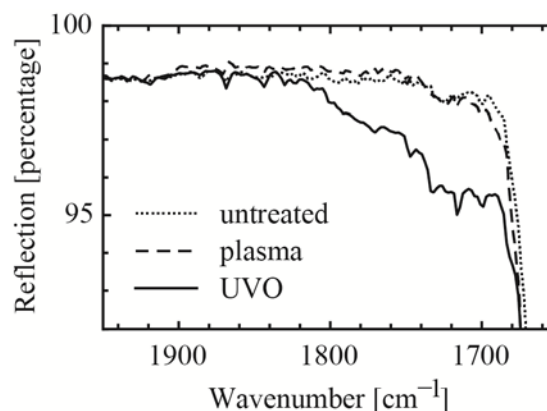


Fig. 1: Characteristic FT-IR spectra of the basic material (untreated), oxygen-plasma- and UVO-treated PEKK films.

**DISCUSSION & CONCLUSIONS:** The correlation between carbonyl signals and the increase in the glass transition temperature after UVO-treatment indicates a chemical ageing of the PEKK films. Therefore, we conclude that plasma treatment using a power of 10 W is favourable for the surface preparation of load-bearing implants made out of the high-performance polymer PEKK. At this moderate plasma power the nanostructuring effect is negligible. Owing to the similar chemical structure, PEKK exhibits a comparable behaviour to the well-established high-performance polymer polyetheretherketone (PEEK).

**REFERENCES:** <sup>1</sup> P. Urwyler, X. Zhao, A. Pascual, H. Schiff, and B. Müller (2014) *Eur J Nanomed* **6**:37-46. <sup>2</sup> P. Urwyler, A. Pascual, M. Kristiansen, J. Gobrecht, B. Müller, H. Schiff (2013) *J Appl Polym Sci* **127** 2363-3270. <sup>3</sup> P. Urwyler, A. Pascual, B. Müller, H. Schiff (2015) *J Appl Polym Sci* **132** 41922.

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