Comparing physical properties of PEKK and PEEK

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INTRODUCTION: High-performance thermo-plastics including polyetheretherketone (PEEK) and polyetherketoneketone (PEKK) are key biomaterials for load-bearing implants. Plasma treatment is a common process to chemically activate polymer surfaces, which is a prerequisite to achieve proper cell attachment. Oxygen plasma treatment of PEEK films results in well reproducible nanostructures [1]. Our goal is the development of nanostructures on surfaces of implants that induce alterations in cell shape and cell differentiation to reach osteointegration of load-bearing polymer implants.

METHODS: Commercially available 100 µm-thick amorphous PEEK (APTIV™ 2000 series, Victrex Europa GmbH, Hofheim, Germany) and 60 µm-thick PEKK (OXPEKK Permetta™, Oxford Performance Materials, South Windsor, USA) were flattened by hot embossing with HEX3 (JENOPTIK AG, Jena, Germany) slightly above their glass transition temperatures. Subsequently, the flattened and virgin films were activated using oxygen plasma treatment (RIE System Plasmalab 80 Plus, Oxford Instruments, Wiesbaden, Germany) with powers from 25 to 100 W for PEEK and from 25 to 150 W for PEKK. Contact angles were measured in triplicate 5 s after adding a 4 µL water droplet to the film at room temperature. Surface roughness and island densities of the surfaces were measured using electron microscopy and in-depth using atomic force microscopy (Dimension 3100 instrument, Veeco, Mannheim, Germany) in tapping mode.

RESULTS: The water contact angle for PEEK decreases from 75 to 37 degrees, while for PEKK from 84 to 7 degrees with the increasing oxygen plasma power. Nanostructures tunable with the plasma intensity are seen for both PEEK and PEKK (cp. Fig. 1). The effect of the nanostructures is more pronounced for flattened films. The induced nanostructures give rise to an increased roughness and decreased island density.

DISCUSSION & CONCLUSIONS: Oxygen plasma treatment is a promising method to build nanostructures and simultaneously activates PEEK/PEKK surfaces for cell seeding. Roughness increased, while island density and contact angle decreased with increasing oxygen plasma power.

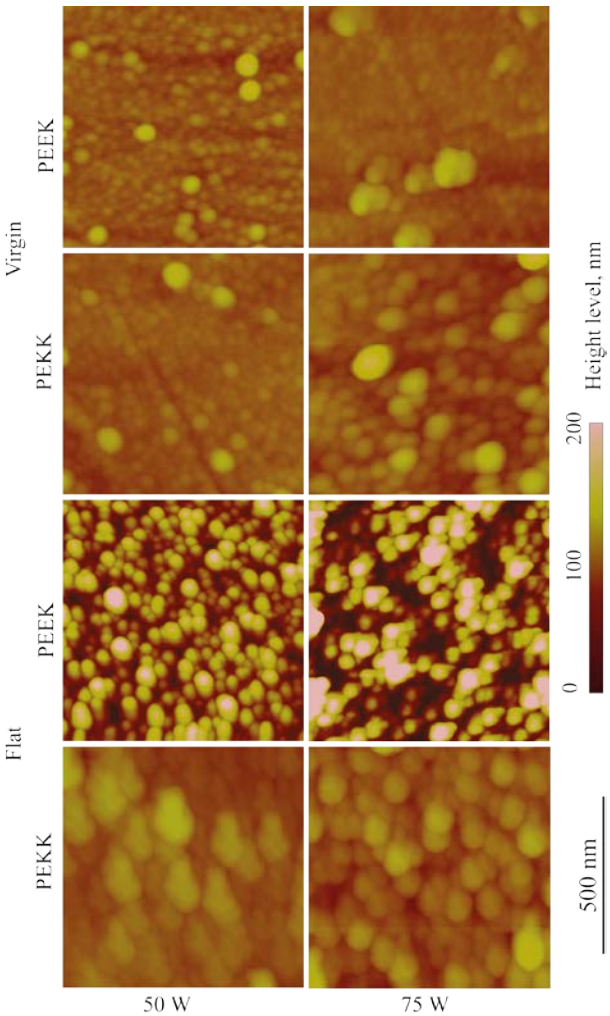

Fig. 1: AFM images of plasma-treated films.

REFERENCE: [1] J. Althaus, C. Padeste, J. Köser, U. Pieles, K. Peters, B. Müller, (2012) *Eur. J. Nanomed.* **4**(1):7-15.

ACKNOWLEDGEMENTS: The authors thank the Swiss Nanoscience Institute and the Swiss Academy of Engineering Sciences for providing financial support. Technical assistance from C. Spreu, S. Stutz, R. Schelldorfer and K. Vogelsang is greatfully acknowledged.