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Metallization of polymers for medical applications using HiPIMS

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In most cases, materials do not meet the requirements for both surface and bulk properties when used as an implant material. An example is PEEK (Polyetheretherketone), a radiolucent alternative to metallic implants well established in the spine surgery community. While having excellent bulk properties like a modulus closely matching cortical bone (18 GPa), an unconditioned PEEK surface is known to display poor bone integration. Therefore, titanium coatings on PEEK by means of titanium plasma spray processes (VPS, APS) have been established, but bear the drawbacks of incomplete and feature reducing surface coverage.
A cost effective coating method with superior adhesion values allowing for excellent replication of the original surface structure is presented. High adhesion strength values (>30 MPa) can be obtained with HiPIMS including penetration into narrow trenches and to surfaces with a high inclination towards the sputter target. Finite Element simulations are used to illustrate that standard adhesion testing according to ASTM D4541 is not applicable to polymer substrates as a strong deformation of the soft substrates leads to incorrect adhesion strength values. It is shown that a tailored surface pre-treatment is essential to secure layer adhesion to the PEEK surface. XPS and ToF-SIMS measurements confirm film qualities compliant to surgical grade II Titanium (ISO 5832-2). SEM is used to study the layer structure with respect to the HiPIMS parameters.

Keywords
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