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Enhancement of PEEK Bioactivity by Plasma Surface Modification

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Introduction:
Polyetheretherketone (PEEK) has recently attracted a lot of attention in orthopaedics, with applications such as the intervertebral spacer, spinal cage and in prostheses. However, the literature suggests this material is bio-inert in nature, its inferior bioactivity possibly lead to poor bone-implant interaction. Surface modification is therefore an alternative as it generates functional groups on the surface of PEEK for biomolecular interaction without changing bulk mechanical properties. This study aims to investigate the feasibility of bioactivity enhancement of PEEK using plasma immersion ion implantation (PIII).

Materials and Methods:
PEEK materials obtained from Quadrant Ltd. were used throughout the study. Water and ammonia PIII treatments were applied to PEEK at 50Hz, 30µs at 10KV, 20KV and 30KV for 2 hours, respectively. Untreated PEEK and titanium discs with the same dimension were used as control. MTT assay and Alizarin Red staining were used to study cell proliferation and mineralization.

Results and Discussion:
According to the result of MTT assay, cell proliferation has been significantly increased from day 2 to day 7 in all the samples. In mineralization test, the red color appeared on sample surface indicates the calcium formed during mineralization. The mineralized area was larger on NH₃ and H₂O treated PEEK than that on the untreated. The result supports the PIII effect on improving bioactivity. In summary, surface modification of PEEK by using water and ammonia plasma immersion ion implantation is found to significantly improve cell proliferation and mineralization. Future experiments such as ALP release and animal study are underway.

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