MSE-4: Post Processing Techniques for PEEK 3D Printed Spinal Fusion Cages

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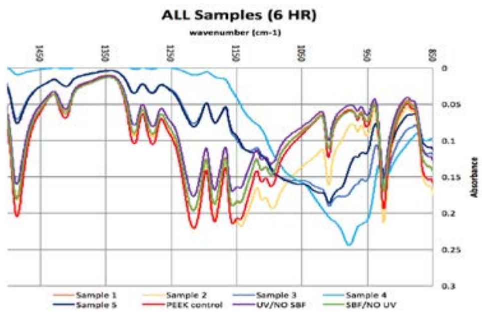
Problem Statement:

- There is a need for spinal fusion implants that promote osseointegration. PEEK has proven to be a viable candidate, but does not promote cell adhesion.
- Calcium phosphate/hydroxyapatite is commonly used in biomaterials to achieve fixation with the implant and bone and increase wettability.

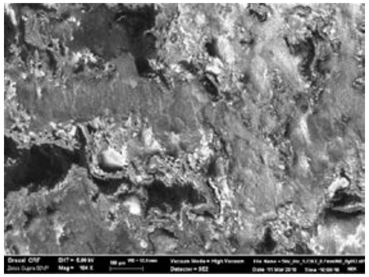
Approach:

- PEEK cages were exposed to UV-A radiation in saturated simulated body fluid solution (2x) to promote the bonding of calcium phosphate to the surface:
  - Time intervals under radiation: 0.5, 1, 3, 6 (hours).
  - Characterization: FTIR, SEM, EDX, and Nanoindentation.
  - Cell culture analysis: cell proliferation assay and detection of alkaline phosphatase enzyme.

Results:



3 out of 5 samples showed peaks found in Calcium Phosphate hydroxide IR



Topography and pore structure of the PEEK coupons *via* SEM

- FTIR – Peaks at around 1000 cm^{-1} confirmed the coating bonded.
- SEM – Images indicated phosphorus and calcium ions on the surface.
- EDX – Showed calcium and phosphorus peaks in the spectrum.

Discussion & Conclusions:

- Time intervals of 3 and 6 hours under UV radiation successfully formed calcium and phosphorous ions on the surface of PEEK:
  - FTIR revealed phosphate (PO_4) groups where there originally were none.
  - SEM showed a dry and flaky surface, which was indicative of hydroxyapatite being coated onto the surface.
- Contact angle measurements showed increased wettability, which is key to achieving osseointegration.

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