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Bioactivity investigation with printed FibreTuff versus HaPeek for medical applications

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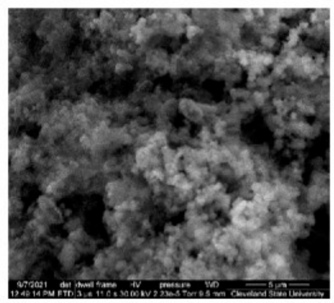
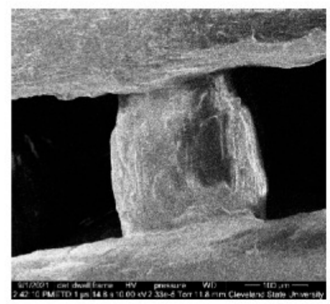
There are few printed biomaterials classified as bioactive, forming a strong chemical bond with the surrounding bone and generating cell proliferation. To date, the bioactivity claims of ingredients used for printing include bioactive glass, and hydroxyapatite (Ha), HaPEEK and recently, FibreTuff.

The bioactive HaPeek will consist of a synthetic hydroxyapatite with Polyether ether ketone (PEEK). This biomaterial will only be bioactive after to 30 to 40% hydroxyapatite content compounded and or blended. The HaPeek biomaterial is radiolucent and considered re sorbable with a resorption rate of 5-15% per year. Furthermore, adding 30% of Ha to PEEK, a loss in mechanical properties is approximately 20 -25% or lower than 50MPa which is borderline cortical bone. The printing of HaPeek has been primarily selective laser sintered (SLS) which produces stiff and brittle printed structure. In some cases, printed porosity is produced to enable cell and tissue growth for scaffold use in mimicking bone.



SEM pictures of SBF+DMEM immersed sample



SEM pictures of SBF+DMEM immersed sample

FibreTuff is bioactive, study released by Dr Prabaha Sikder at Cleveland State University, November 2021, and a non re sorbable biomaterial composition. FibreTuff can be produced in a filament and powder for printing in several methods to include FDM and SLS. The FibreTuff tensile strength of 45MPa can be designed and printed with more mass and fiber alignment to surpass greater scaffold strength than HaPeek. Furthermore, biomaterial relies on the principle's of real bone consisting of inorganic and organic components. The inorganic ingredients are mineral playing a vital role in defining cell identity and driving tissue specific functions. The organic component comprises a protein backbone for cell and tissue proliferation. This is unlike any other printed bioactive materials to date. Other differentiators from the above bioactive biomaterials include the following:

1. FibreTuff has been printed in a very small micropore structure 60-80 micron conducive to bone ingrowth, unlike PEEK which is printed on a micropore structure >120 micron. FibreTuff includes cellulose which doesn't conduct heat for faster cooling when printed.
2. FibreTuff has radiopacity, showing an implant location and bone bridging (Real bone would be brighter than FibreTuff and HaPEEK is radiolucent) Nevertheless, FibreTuff could generate healing data for artificial intelligence to support a patients progress.
3. FibreTuff has hydrophilic ingredients with absorbent qualities to reduce brittleness and improve flexibility and impact.

Reference

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