Developing medical materials- Novel Polyether ether ketone composites

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The current arsenal of biomaterials available for orthopedic and dental surgeons is truly vast and encompasses many forms, including: metals, ceramics and polymers. Needless to say, a great many of the biomaterials in these categories perform their tasks exceptionally well. However, that does not mean we should become complacent as it is within our current capabilities to develop more exceptional biomaterials.

A priority of this EngD project is the development of a novel composite formulation for medical applications. The materials that will be used include polymers such as Polyether ether ketone (PEEK) and ceramics such as hydroxyapatite (HA).

PEEK is a highly robust aromatic polymer used in a variety of applications. Its success is owed to the attributes possessed by the polymer, which include excellent thermal stability, chemical resistance and high strength. In terms of medical utilisation, PEEK can be used in high load bearing applications such as spinal fusion cages and hip stems [1].

HA (Chemical formula: $Ca_{10}(PO_4)_6(OH)_2$) is a bio ceramic material, best known for being the inorganic constituent of bone. As well as being biocompatible, it is also osteoconductive.

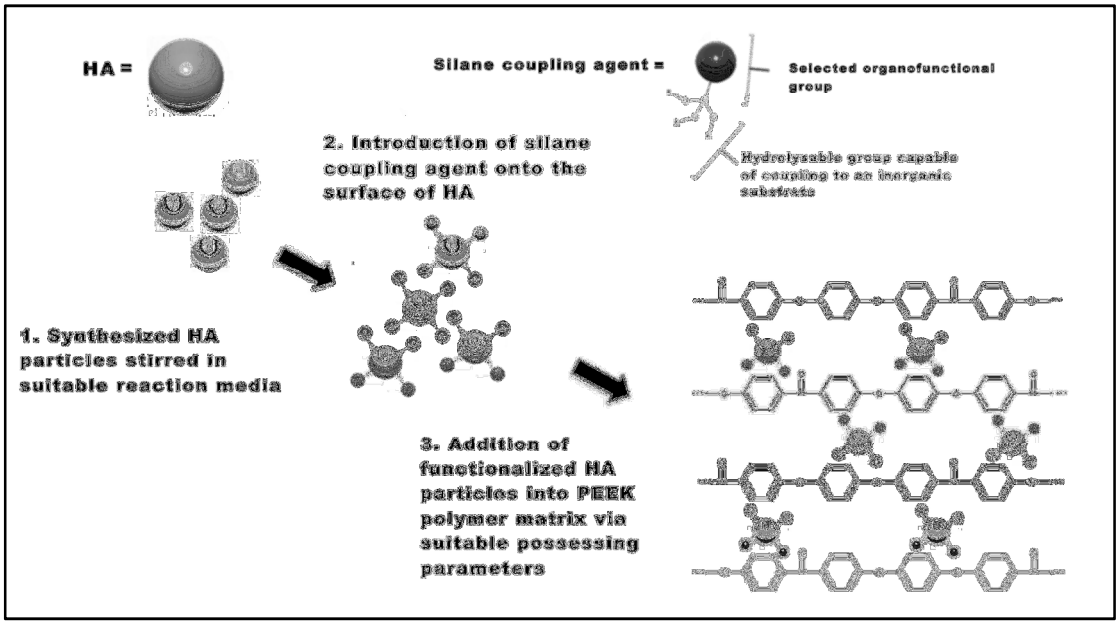

Figure 1. Schematic of silane functionalization HA and introduction of modified HA into the PEEK polymer matrix

The development of HA/PEEK composites has evidently been explored thoroughly throughout the literature. The use of HA provides PEEK with the osteogenic properties it lacks [2]. One of the main issues with the combining of a high performance polymer and a ceramic to form a composite is the inevitable trade-off in mechanical properties [1]. Currently, this area leaves a lot to be

desired, with at best the incorporation of HA particles in the matrix being secured purely from the entanglement within the polymeric matrix [3].

The challenge lies in achieving a strong interaction at the interface between the polymer matrix and the HA particles. Achieving this could by-pass the issue of mechanical property trade-off that hampers many similar composite formulations. Silane functionalization on the surface of HA particles could hold the key to over coming this issue by providing the opportunity to develop stronger interaction between the hydroxyapatite particles and the PEEK matrix through various chemistries.

References

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