Editorial: Chemically substituted apatites for biomedical applications

The last three decades has placed significant attention on apatites as candidates for biomedical applications. Research was initially focused on pure hydroxyapatite and studies included: investigations of crystallite formation using a range of chemical processing routes; densification by thermal processing, characterisation and testing of the manufactured implant materials. A large variability has been reported due to the use of different reactants and the consequent range of both chemical- and phase purity. Despite this, understanding of apatites has developed to a sufficient level for significant growth of the field.

It is well recognised that apatites are found as calcified deposits in biological systems and geological minerals. The apatite structure is very accommodating of a large range of ionic, anionic and chemical group replacements. Research on bone already resulted in the development of methods for measuring the Ca/P molar ratio, carbonate, fluoride and concentration of several divalent metals. A combination of elemental impurities both at trace levels and in higher concentrations has equipped biomedical researchers for more thorough research of apatites and has provided us with the ability to precisely determine the chemistry of chemically modified apatites. This has followed through into the Biomedical literature concerning apatites which is now starting to report the production of materials with concentrations of elements in addition to calcium and phosphate.

A less obvious modification to the chemical environment arises from imperfections or a change in structure from the hexagonal to the monoclinic crystal structure. These studies are more complex, requiring expensive equipment and time consuming specimen preparation to learn how the chemical environment is modified from processing, or the intentional addition of different elements or chemical groups. This contribution to the knowledge-base of apatites will occur more slowly, but is already apparent from studies on apatites manufactured from different processes. For example, the effects of defects and crystallinity are apparent in thermal spraying of hydroxyapatite which provides a higher solubility and thus a more resorbable bioceramic compared to a sintered implant made from the same composition material.

This collection of papers stems from a session on chemically modified apatites at the 7th World Biomaterials Congress in Sydney, Australia in May, 2004. The range of papers reveals the synthesis, production, characterisation, properties and *in-vivo* testing of chemically modified hydroxyapatite. Work has ranged from synthesis of chemically enriched apatites, chemical treatment of teeth, and revealed the apatites found in calcified deposits associated with biopolymers.

The ability to control the properties of hydroxyapatite by chemical modification is playing a more important role for new implant forms in orthopaedics and dentistry, such as porous materials and will extend the range of applications of hydroxyapatite to other biomaterial applications.

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