



### ADDRESSING THE CHALLENGES IN THERMAL SPRAYING OF BIOCERAMICS

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**18<sup>th</sup> December 2009, Friday, 11:00 a.m. – 12:00 noon**  
**Science Lecture Theatre S2**

The thermal spray process is basically the spraying of molten material onto a surface to form a coating. Sprayed material in the form of powder is injected into a very high temperature flame, where it is rapidly heated and accelerated. The molten droplets would impact on the substrate surface, flatten, spread and rapidly cool (up to  $10^6$  K/sec), forming splats. The final coating consists of thousands of splats impacting and solidifying on top of each other. This relatively simple process can be used to coat various engineering surfaces. Applications of thermal sprayed coatings ranged from aerospace to biomedical devices. Hydroxyapatite (HA) is a calcium phosphate ceramics used especially in orthopaedic, dental and maxillofacial applications. Stoichiometric composition of its chemical formula may vary, however, it is generally indicated as  $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ . Hydroxyapatite, classified as a bioactive material, is chemically similar to the mineral component of bones and hard tissues in mammals, hence it has the ability to integrate into bone structures and support bone ingrowth, without breaking down or dissolving. By itself, HA does not have sufficient mechanical strength to succeed in long-term load bearing applications. Therefore it is used as a coating material for common metallic implant materials (e.g. titanium, stainless steels) which carry most of the load. Covered by a layer of HA, the implants are much better accepted by surrounding tissues. To date, the only reliable method of applying HA coatings to metallic implants is through thermal spray. This talk will present the work performed at NTU on thermal sprayed bioceramics, with particular emphasis on the challenges encountered in phase changes and tailoring of process parameters in order to achieve the desired phase composition in the coatings. Post-spray treatment studies using spark plasma sintering (SPS) technology will also be discussed.

Professor Michael Khor obtained his BSc and PhD from Monash University. He worked as an Experimental Scientist in CSIRO before joining Nanyang Technological University (NTU) in 1989. He has held the position of Director of Research at NTU (2004-2008) and Deputy Director, Singapore-MIT Alliance prior to joining the National Research Foundation in March 2008. He is on the editorial board of 4 international journals on biomaterials, applied ceramics, and materials science and technology. His research focus on nano-bioceramics and nano-composites, spark plasma sintering of nano-materials and nano-powders (metals and ceramics), thin films, thermal sprayed coatings, thermal barrier coatings for aerospace applications and solid oxide fuel cells.

Visitors are most welcome: Please note the parking arrangements. There is a designated Visitors Car Park (N1) clearly ground-marked by white paint and tickets, at a cost of \$3/day, are available from a dispensing machine. ('Blue' permit designated areas are for Monash members only.). It is also possible to park at other designated Visitors Car Parks (E1, S1 and S2) on the Clayton Campus, but tickets are \$1.4/hour.

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