

## **ABSTRACT**

Biomaterial Components Prepared by Titanium Powder Technology  
by Mikael Eriksson

The main objectives of this work were twofold: First, to determine if a pressed-powder method could be used to fabricate titanium dental copings, and to line out what problems or benefits this new method would have. Second, to test if high velocity compaction of titanium powder could be used to form biomaterial components such as copings or dental implants. The dental components were prepared from pure titanium powder, with irregular grains (hydrided-dehydrided) beneficial for pressing. The powder was pressed against a mandrel (tooth preparation die) using cold isostatic pressing. The tooth preparation dies and the copings were fabricated using a milling machine working with scanned dental shapes, digitally enlarged to compensate for the sintering shrinkage. The materials were sintered using vacuum-furnaces and investigated with several techniques. A deformation problem on the copings was investigated. High velocity compaction was studied as an alternative method to prepare dental copings and simulations of this process was initiated. Hydroxyapatite grains of a narrow size-range was mixed with a titanium powder and formed with high velocity compaction to form a composite material.

A method to manufacture up to 99% dense and ductile titanium copings was developed. The sintering shrinkage could be compensated for. The main cause of the deformation was found to be a deformation effect on the tooth preparation dies. Other possible deformation causes were small. Sintered copings of various shapes could be prepared. Very high green densities were obtained by using high velocity compaction and a method using elastic forms to prepare copings was developed. Initial simulation results were reached to better understand the compaction behaviour and to find the best form geometry. A 99% dense titanium-hydroxyapatite biomaterial composite was prepared without detectable destructive reactions. The method worked to fabricate titanium dental copings of various shapes into an approved fit. The mandrel material turned out to be the most important factor to consider for avoiding deformation. Density gradients in pressed titanium were found but were small. Dental copings could also be prepared with high velocity compaction. A dense composite of titanium and hydroxyapatite could be prepared and composite implant components were manufactured.

### **Keywords:**

titanium powder, dental, coping, crown, deformation, cold isostatic pressing, high velocity compaction, biomaterial, titanium-hydroxyapatite composite, powder metallurgy.