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Bioceramic Tooth Model to study Caries

S. Stevanovic[1], L. Kind[1], A. Wüthrich[1], U. Pieles[1], M. Hug[2], D. A. Lysek[2]

[1] University of Applied Sciences and Arts Northwestern Switzerland (FHNW), sabrina.stevanovic@fhnw.ch
[2] credentis ag, mh@credentis.com

Introduction

Wide variability of human teeth, due to intrinsic features, renders standard studies challenging [1]. Furthermore it is difficult to access usable human teeth because of the limited availability. We developed an *in vitro* model simulating the characteristics of enamel and dentin of human teeth. The bioceramic tooth model allows a standardized introduction of artificial carious lesions (white spot) and the study of biorемineralization.

Methods

Artificial tooth models (phantom body, PB) with the characteristics of enamel and dentin were manufactured by mechanic compression of hydroxyapatite (HA) powder, followed by thermal treatment. Two different types of PBs (enamel and dentin-like) were fused together using phosphoric acid to mimic the enamel / dentin junction of human teeth. To induce artificial lesions, the enamel-like PB was exposed to an acidic solution. Analytics were performed using Mercury Intrusion Porosity (MIP), Brunauer, Emmett, Teller (BET) gas adsorption, Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), Vickers Hardness (VH) and µ-Computer Tomography (µ-CT).

Results

Figure 1. Final PBs, blue the enamel-like and white the dentin-like PBs. On the right side assembled specimens are displayed.

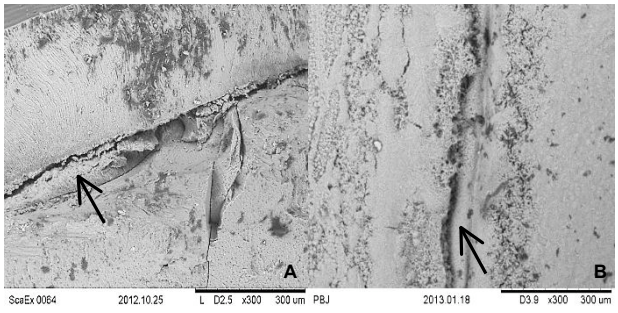

Figure 2. (A) SEM image (x300) of enamel (upper) / dentin junction (arrow) of an extracted human tooth. (B) SEM image (x300) of assembled enamel (left) / dentin PBs, showing similar morphology (arrow).

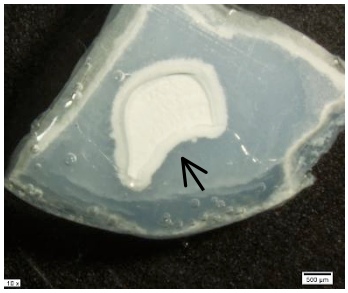

Figure 3. Enamel-like PB with an artificial lesion (arrow).

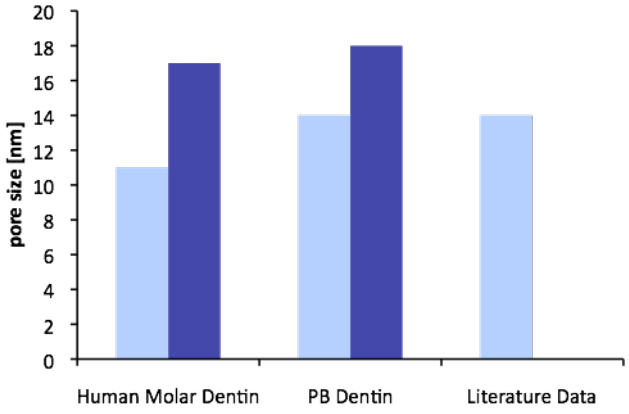

Figure 4. Measured pore size by (•) MIP and (•) BET of human coronal molar dentin, PB dentin and literature data [2].

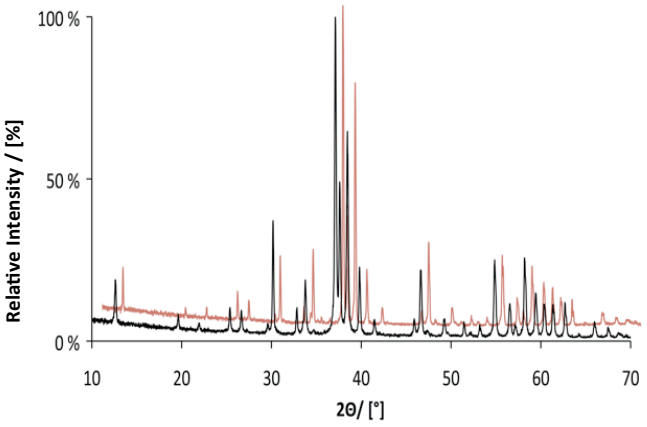

Figure 5. XRD diffractogram of the enamel-like PB (black), crystallinity grade comparable with pure crystalline hydroxyapatite (red).

Artificial tooth models based on compressed synthetic HA could be successfully produced (**Figure 1**). The data obtained were comparable with the human molar tooth **(Figure 4, 5)**. Assembling the selected specimens (**Figure 1 and 2**) as well as introduction of artificial lesions (**Figure 3**) was successfully performed.

Conclusions

In this study we present a successful technology to process raw ceramic material into an artificial tooth model with similar mechanical and chemical properties of human teeth. Studies on biomimetic mineralization by a 3D-self-assembled peptide are in process. This artificial model allows to study and develop innovating compounds for biomineralization.

Acknowledgements

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