European Cells and Materials Vol. 10. Suppl. 5, 2005 (page BS20) ISSN 1473-2262

Innovative Method for the Production of Similar TiO_2-coated Epoxy Replicas Used in Cell Culture Assays

M. Schuler[1], T. P. Künzler[1], C. M. Sprecher[2], M. de Wild[3], S. Tosatti[1], M. Textor[1]

[1]*Dept. of Materials, Federal Institute of Technology (ETH), Zürich, Switzerland,*
[2]*AO Research Institute, Davos, Switzerland,* [3]*Institut Straumann AG, Basel, Switzerland*

INTRODUCTION: Surface topography has been shown to be one of the important surface characteristics affecting cell response[1]. In the past, diverse fabrication methods such as micro machining, plasma spraying, particle blasting and/or acid etching have been applied to fabricate stochastically rough micro- and nano-topographies[2]. However, there is a substantial need for cost-effective methods to produce large numbers of samples with identical surface topographies, without the need for specialized surface treatment such as blasting. Our concept of sample production is based on an epoxy replica technique using dental impression material[3]. The aim of this study was the investigation of surface roughness over several generations of epoxy replicas using standard surface characterization techniques.

METHODS: Masters of a rough (SLA; sand-blasted, large-grit, acid-etched; Institut Straumann AG) CP Ti disc were produced using dental impression material (vinyl polysiloxane). These samples served as negative replicas to cast epoxy resin. Cured epoxy substrates were coated with a 60 nanometer (nm) thick film of titanium oxide using reactive magnetron sputtering. Vinyl polysiloxane masters were cleaned and reused for the fabrication of further generations of epoxy replicas (up to a total of eight casts). Surface topography was characterized with White Light Confocal Microscopy. In the Scanning Electron Microscope (SEM), the same surface area was controlled over several generations. The chemical composition of the sputter-coated titanium oxide film was investigated with X-Ray Photoelectron Spectroscopy.

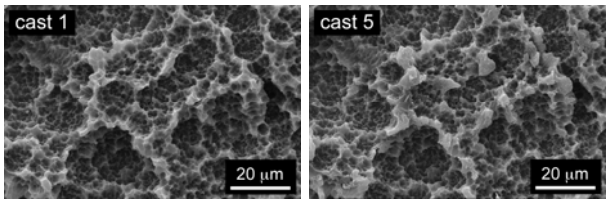

Fig. 1: Scanning electron micrographs of two different TiO_2-coated epoxy replicas made from SLA CP Ti disc. Left panel: first cast; right panel: fifth cast using the same vinyl polysiloxane master.

RESULTS: Roughness values R_a and R_t (measured with optical prolifometry) were the same within experimental uncertainty over all eight generations and in comparison to the original SLA CP Ti disc (Fig. 2).

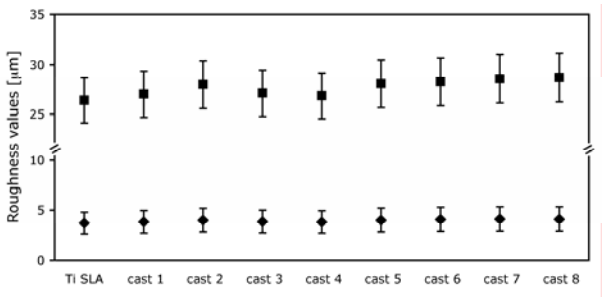

Fig. 2: Roughness values R_a (◆) and R_t (■) measured with White Light Confocal Microscopy (770 x 798 µm^2) of a CP Ti SLA disc and its eight generation replicas.

SEM investigations showed comparable topographies over all the eight consecutive casts. Only very rarely, some additional features were detected due to material transfer between casts. (Fig. 1, right panel). The chemical composition of the titanium oxide film showed pure TiO_2 (data not shown).

DISCUSSION & CONCLUSIONS: The epoxy replica technique is a simple and powerful tool to produce series of samples with essentially identical surface topographies. Such sample sets have the advantage of improving reproducibility and comparability in standard cell culture experiments. It is possible to use the same vinyl polysiloxane negative for the production of at least eight generations of epoxy replicas although the SLA surface used in this study is a highly complex 3-D topography with undercut features. The surface chemistry of epoxy substrates sputter-coated with TiO_2 is comparable to the native oxide film on the original SLA CP Ti surface.

REFERENCES: [1]Boyan *et al.*, in *Titanium in Medicine*, Springer-Verlag, p. 561-586, 2001. [2]Sykaras *et al.*, *Int J Oral Maxillofac Implants*, **15**: p. 675-690, 2000. [3]Wieland *et al.*, *J Biomed Mater Res*, **60**(3): p. 434-444, 2002.

ACKNOWLEDGEMENTS: This project was supported by the ITI Foundation for the Promotion of Oral Implantology, Switzerland.