

HYFRASURF – ADVANCED SURFACE TECHNOLOGY FOR SUPERIOR ELECTRODE PERFORMANCE

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INTRODUCTION: In recent years much effort has gone into prolonging the lifetime of batteries in pacemakers. The focus has been mainly on the optimisation of the battery and on a higher integration of the electronic circuits and consequently a lower power consumption. By introducing a modification of the electrode tip it has been possible to reduce power consumption with the potential for further optimisation.

METHODS: The HyFraSurf technology (HyFraSurf = Hybrid Fractal Surface Topography) is based on a micro-fractal treatment and coating deposition process (Fig. 1).

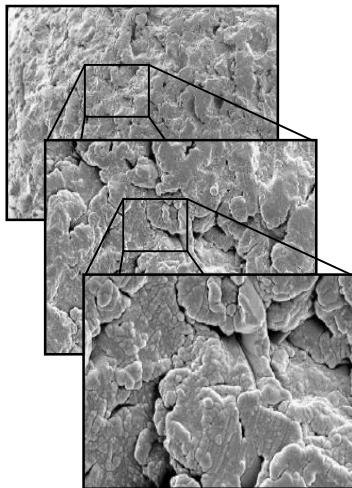


Fig.1: Fractally structured surface of HyFraSurf-treated electrode tips.

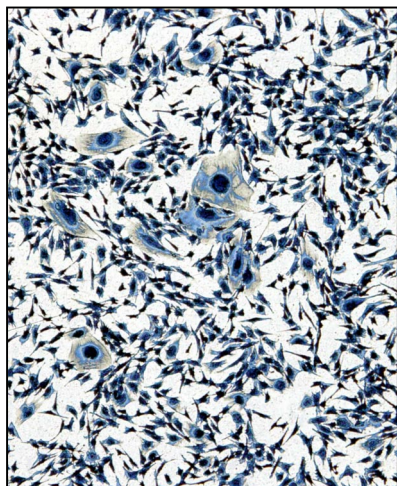


Fig.2: Polarisation Voltage and Double Layer Capacity of different surface modifications.

RESULTS: Sulzer Innotec has developed a proprietary surface treatment, which has demonstrated higher double layer capacity and

lower polarisation voltage. By adapting the process parameters, the modification can be optimised for different requirements (Fig. 2).

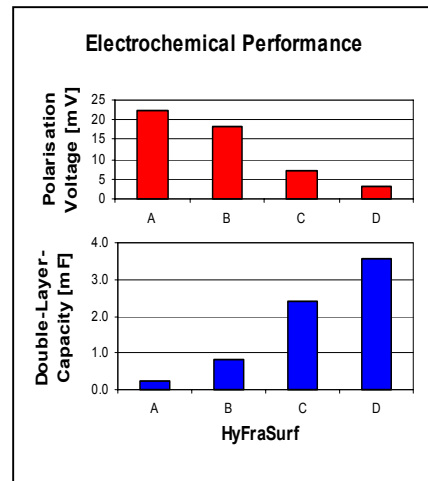


Fig. 3: *In vitro* test of bacterial proliferation on HyFraSurf surface modification.

Biocompatibility was tested *in-vitro*. The results of the cell culture tests showed good cell coverage (Fig.3). Compared to the untreated reference surface, HyFraSurf demonstrates excellent biocompatibility.

DISCUSSION & CONCLUSIONS: For artificial stimulation of the heart, the electrode current, which is carried by electrons, has to be coupled into the tissue, where ions are the main contributors to conductivity. To achieve this coupling effectively it is necessary to create a high double layer capacitance and a low polarisation voltage at the interface. By depositing a highly biocompatible coating displaying a micro-fractal surface topology, the double layer capacity and the polarisation voltage can be influenced. A strong correlation between the increase of the double layer capacity and the decrease of the polarisation voltage is present. Therefore, the electrical resistance of the interface between electrode tip and tissue is significantly reduced. Furthermore, HyFraSurf can be tailored to meet specific electrochemical requirements.

REFERENCES: J. Brehme, V. Biehl, A. Hofmann, *Adv. Eng. Mat.* 2, 2000, 270-275. M. Schaldach, M. Hubmann, M. Hardt, R. Weike, A. Weike, *Biomed. Technol.* 1989, 185. J. Riedmüller, A. Bolz, H. Rebling, M. Schaldach, *Proc. 14th ann. Int. Conf. of the IEEE/EMBS 1992*, 2364-2365.