

## XPS Study of Iridium Oxide Coating Material for Cardiovascular Application

Liliana L. Atanasoska, Charles Z. Deng, and Pankaj Gupta  
Boston Scientific Corporation, Maple Grove, MN, USA

Iridium oxide thin films have been a subject of considerable research interest due to biomedical applications such as electrodes for pacing and neural stimulation. Iridium oxide is an electrically conductive, valence-change metal oxide that crystallizes in the rutile structure with excellent charge injection properties.<sup>1</sup>

Understanding surface properties of iridium oxide is crucial for potential cardiovascular stent application because of its catalytic effect on hydrogen peroxide decomposition, which is hypothesized to affect healing and restenosis rate.<sup>2</sup>

Iridium oxide films can be formed by many different processes, for instance, by thermal decomposition, reactive laser ablation, or electrochemical deposition. Surface characteristics and desired performance of iridium oxide can be controlled by selecting a suitable process and by adjusting process parameters.

The iridium oxide thin films in this study were formed by physical vapor deposition<sup>3,4</sup> with selected process parameters and analyzed by X-ray Photoelectron Spectroscopy (XPS), Scanning Electron Microscopy (SEM), Electrochemical Impedance Spectroscopy (EIS) and Cyclic Voltammetry (CV).

Nano-structured morphology typical for all investigated iridium oxide films is shown in Figure 1. High resolution O 1s core level XPS spectra of iridium oxide films produced under two different processing conditions are shown in Figs 2 and 3.

The shift in Ir 4f core level spectra can not be unambiguously used to determine different oxidation state of iridium in its oxide.<sup>5</sup> However, the O 1s photoemission peak shape clearly show the differences in iridium oxide stoichiometry produced with the selected PVD process parameters. The ratios of Ir-O single  $\sigma$  bonds and Ir=O double  $\pi$  bonds in the films formed under the examined processing conditions were determined by curve fitting analysis of the O 1s photoemission, after subtracting the overlapping contribution of carbonyl oxygen from the present carbon contamination.

A correlation between the XPS derived stoichiometry of the examined iridium oxide films and their electrochemical performance has been established. The implication of these findings on the iridium oxide catalytic effect on hydrogen peroxide decomposition as well as on its charge injection performance for pacing and neuro-stimulation is discussed.

### References:

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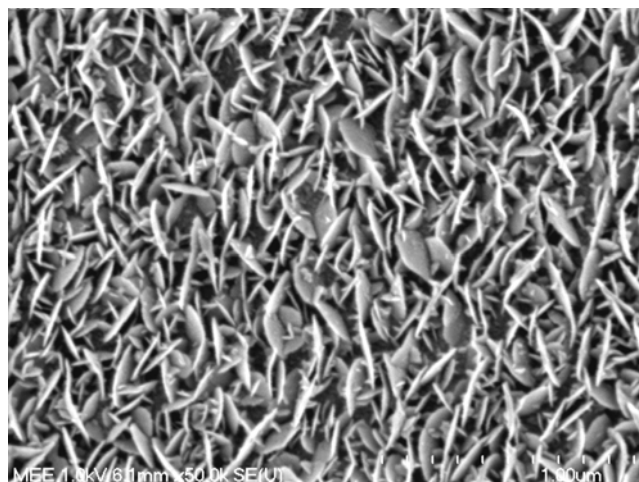


Figure 1. SEM image of Iridium Oxide.

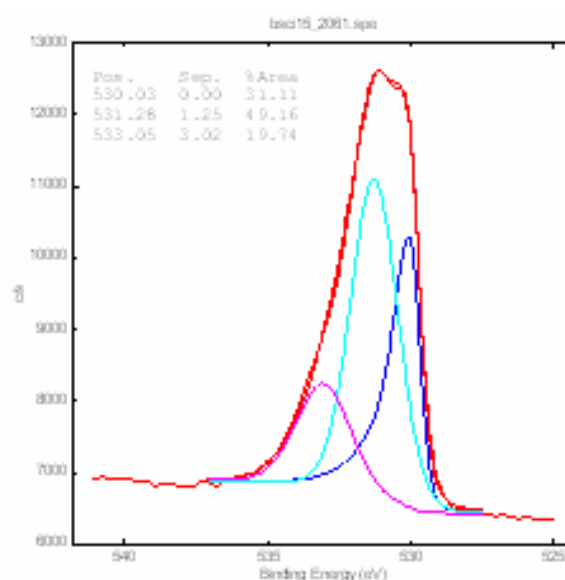


Figure 2. Oxygen 1s spectrum A.

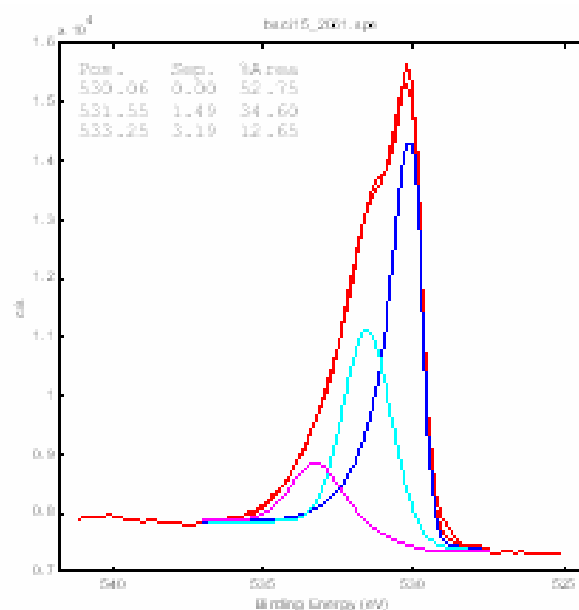


Figure 3. Oxygen 1s spectrum B