Accelerated hermeticity testing of biocompatible moisture barriers used for encapsulation of implantable medical devices

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Acceleration protocol plays an important role on barriers reliability evaluation for encapsulation of long-term implantable medical devices. Typically, acceleration is realized by performing tests at elevated temperature: the higher the selected temperature, the higher the acceleration factor. Nevertheless, at high temperatures, reaction mechanisms might be different, resulting in false acceleration test results. Our standard barrier performance test is based on the evaluation of corrosion of copper patterns (resistivity check, Electroscopic Impedance Spectroscopy (EIS), microscopic inspection). The temperature window for accelerated testing has been investigated for our standard barrier tests. The copper patterns, protected by a barrier layer under test, are immersed in PBS (Phosphate Buffered Saline) at temperatures up to 95°C. As barriers the following material/multilayers are selected: (1) Al_2O_3 ALD, (2) stacked $HfO_2/Al_2O_3/HfO_2$ ALD (further called ALD-3), (3) polyimide, and (4) polyimide/ALD-3/polyimide. In this presentation, the results of the test protocol evaluation will be presented. As expected, the maximum applicable test temperature is dependent on the barrier under test. Furthermore, during the fine-tuning of the accelerated test protocol, we observed for some barriers a clear influence of the shape of the Cu test patterns on the barrier performance. This can be related with processing effects when fabricating the barrier on the copper patterns. This finding stresses the determination of relevant copper patterns -or test structures in general- in order to predict the barrier performance correct for each individual application.