Multi-layer Stacked ALD Coating for Hermetic Encapsulation of Implantable Biomedical Microdevices

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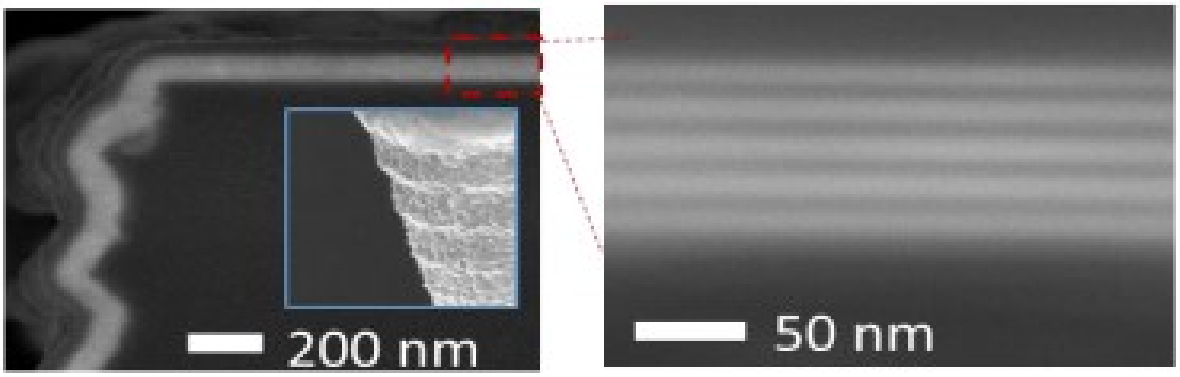
Implantable biomedical electronics are a promising technology for medical diagnosis and treatment if they can be made safe for chronic use. There is thus a growing need for compact-volume hermetic packaging methods for miniaturized biomedical implants. Here we describe the use of multi-layer ALD films comprising HfO_2 and SiO_2 to hermetically encapsulate microscale wireless active electronic implants for use in the brain. The robustness of the 3-D conformal ALD coatings is validated using an accelerated aging test by application of thermal stress (87°C saline) and quantified in terms of water/ionic ingress (leakage currents) as well as overall device performance (the latter via wireless interrogation). ALD coated devices have an extrapolated physiologic temperature lifetime of > 10 years under active electric field stress. Failed devices maintain the layer integrity, and only show gross anomalies on SEM at sample edges likely consistent with handling stresses. This performance is not impacted by opening apertures in the coating (for fabrication of sensing/actuating interface electrodes).

Figure 1 – SEM images of substrate plane and edges demonstrating continuous ALD films



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