STEM

Low-Cost, Biocompatible, Long-Term Packaging Technique for Implantable Medical Devices

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Traditional commercial packaging for biomedical devices makes use of titanium as a biocompatible material; however, titanium increases manufacturing costs and absorbs RF signal communication. Polymer-based packaging for medical devices in vitro has been shown to be biocompatible, wireless communication compatible, and less expensive to manufacture. Our study presents a packaging technique for micro-devices that makes use of polymer-based packaging that offers longevity. This technique uses five layers consisting of polydimethylsiloxane (PDMS), Parylene C, and rigid acrylic. The fabrication begins with the laser machining of the rigid acrylic case and Parylene C coating of the device. The casing is an assembly of three acrylic pieces: a 5-mm spacer and two 2-mm pieces for the top and base, which are bonded together and filled with PDMS. These packages were tested in vitro in a phosphate-buffered saline (PBS) solution at 40°C and 80°C, representing body temperature and acceleration temperature, respectively. The PBS was dyed to expose leaking. Ten packages were placed in the 80°C solution and nine in the 40°C solution. The time it took each group to fail was monitored daily for a few months. In the first month at 80°C there were two failures due to leaking and one due to mishandling. There were no failed packages at 40°C during the first month. Several more packages failed during the following months in both groups. Our study showed that a polymer-based packing technique for an implantable bladder pressure sensor could be useful at human body temperatures. Further improvements are needed to make this packaging technique clinically viable.

Research advisor Albert Kim writes, “The current packaging used for implantable biomedical devices requires high costs and in-house know-how to prevent failure. Pablo’s project generalized the packaging technique using low-cost multi-layer biocompatible polymers, and his investigation confirmed the reliability and stability of the technique. We anticipate that his study will contribute to the development of packaging for implantable biomedical devices.”

Testing the packaging technique on an implantable bladder pressure sensor.

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