METHODS TO FABRICATE HIGH DENSITY FEEDTHROUGHS WITH HERMETIC SEALS

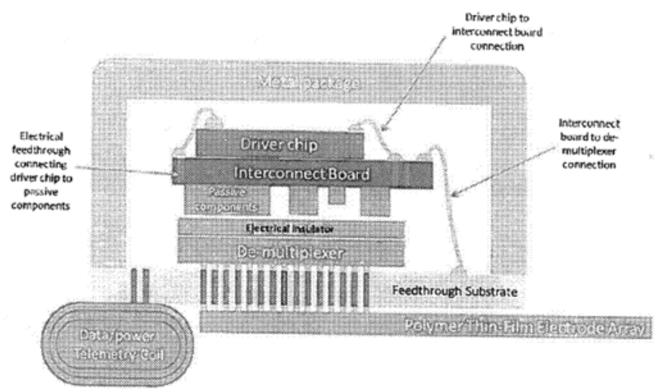
Background

Any sort of implant, whether a pacemaker, deep brain stimulator pulse generator, or cortical implant, must be hermetically sealed to both protect the internal electronics of the device from the surrounding corrosive biological environment, and protect the patient from the potential toxicity of the electronics components.

The central challenge of any implant is to hermetically seal the electronic components, while maintaining sufficient feedthrough channels for external electronic communication. Typically, as the task complexity of a device increases, more feedthroughs are required. However, for each feedthrough, many surface-surface interfaces are introduced, each of which is a potential point of hermetic failure and leakage.

This LLNL portfolio encompasses multiple novel methods to fabricate high density feedthroughs for implantable devices and other packaging needs, while ensuring hermetic seals.

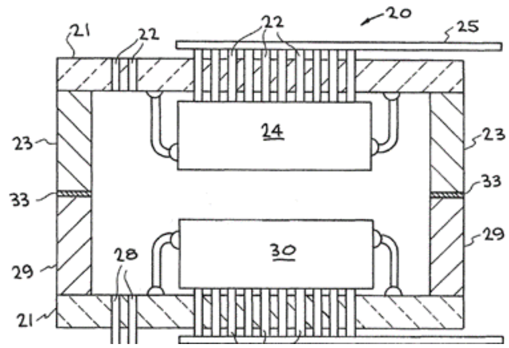
IL12575: MULTI-ELECTRODE NEURAL PROTHESIS SYSTEM (US Patent Application US2016/0030753)



This invention entails a hermetically sealed electronics package of a multi-electrode neural prosthesis system, where the sealed enclosure communicates with external components via feedthroughs. The feedthrough density is increased, however, via signal demultiplexing prior to feedthrough submission.

This invention improves performance of long-term wireless, implantable devices by increasing signal density via demultiplexing. Additionally, this reduces the overall electronics package size, which is especially important in neural implants. The demultiplexing also reduces wireless data/power telemetry limitations.

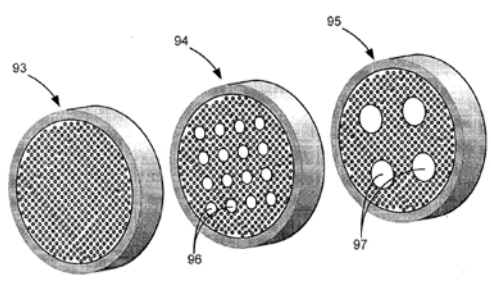
IL12439: HERMETIC ELECTRONICS PACKAGE WITH DUAL-SIDED ELECTRICAL FEEDTHROUGH CONFIGURATION (US Patent 9,504,177)



This technology is a hermetic electronics package, made of a metal case with opposing first and second open ends, with each end connected to a first feedthrough construction and a second feedthrough construction. Each feedthrough construction has an electrically insulating substrate and an array of electrically conductive feedthroughs, to form a hermetically sealed enclosure. A set of electronic components are located within the hermetically sealed enclosure and are operably connected to the feedthroughs of the first and second feedthrough constructions to electrically communicate outside the package from opposite sides of the package.

This device may improve performance of implantable devices by increasing feedthrough density of hermetically sealed devices through its dual sided design.

IL12403: METHOD OF FABRICATING HIGH-DENSITY HERMETIC ELECTRICAL FEEDTHROUGHS USING INSULATED WIRE BUNDLES (US Patent 9,333,337)

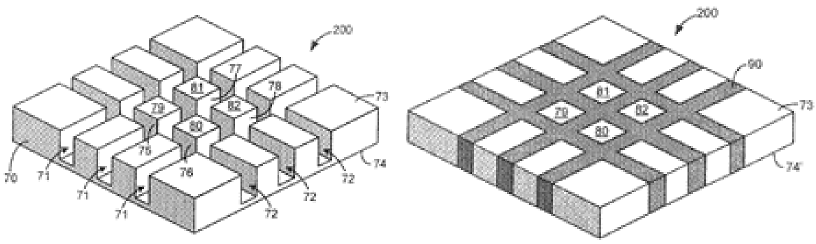


This technology discloses a method of fabricating electrical feedthroughs using multiple electrically conductive wires, which are covered with an electrically insulating material that bundles the coated wires together in a substantially parallel arrangement.

The bundled coated wires are secured to each other by joining the electrically insulating material of adjacent wires together to form a monolithic block which is then cut transverse to the wires to produce a block section having opposing first and second sides with many electrically conductive feedthroughs extending between them. This process forms a hermetic electrically conductive feedthrough construct with an array of electrical feedthroughs extending between the first and second sides of the substrate.

This technology provides a scalable fabrication method for producing high-density, bio-compatible, hermetic electrically conductive feedthroughs in a range of substrate thicknesses. Additionally, this process improves the hermetic bond between feedthrough and insulator by using a lower temperature process for insulator sealing.

IL12382: METHOD OF FABRICATING HIGH-DENSITY HERMETIC ELECTRICAL FEEDTHROUGHS (US Patent 9,048,012)

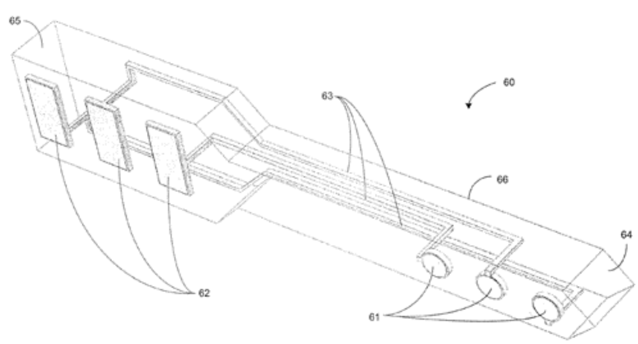


This technology discloses a method for fabricating high-density electrical feedthroughs resulting in a hermetic seal. The method entails removing substrate material from a side of an electrically conductive substrate (e.g. a bio-compatible metal) to form an array of electrically conductive posts in a substrate cavity. Then, an electrically insulating material (e.g. a bio-compatible sealing glass) is used to fill the substrate cavity and surround each post, and solidified.

This process forms a hermetic electrically conductive feedthrough construct with an array of electrical feedthroughs extending between the first and second sides of the substrate.

This method is highly scalable, creates high-density arrays, and uses bio compatible material. Additionally, this hermetically-sealed feedthrough fabrication process uses lower temperatures than other methods, limiting the introduction of temperature-induced micro fractures and points of potential failure.

IL12524: CONFORMALLY ENCAPSULATED MULTI-ELECTRODE ARRAYS WITH SEAMLESS INSULATION (US Patent 9,498,617)



This technology forms a thin-film multi-electrode array having multiple electrically conductive beams, which are conformally encapsulated in a seamless block of electrically insulating material. The method involves adding and removing scaffolding, to form a seamless block of electrically insulating material that conforms to the shape of the suspended trace beam structure. Electrical contacts, electrodes, or leads of the traces are exposed from the encapsulated trace beam structure by removing the substrate. This method of fabrication uses advanced, reproducible, microfabrication processes.

This method forms zero polymer-polymer interfaces, which further limits the chance of delamination and device failure.

Potential Applications

These disclosed inventions may find use in retinal/neural prostheses, cochlear implants, deep brain stimulation, tissue stimulation and monitoring, cortical implants, electrocorticography, and peripheral nervous system implants.

Additionally, these technologies provide methods for the fabrication of any device requiring a hermetic seal: pacemakers and other implants, use in the semiconductor industry, separating sensors from harsh field environments, within the broader packaging industry, and sealing toxic components from the environment.

Development Status

LLNL is seeking industry partners with a demonstrated ability to bring such inventions to the market. Moving critical technology beyond the Laboratory to the commercial world helps our licensees gain a competitive edge in the marketplace. All licensing activities are conducted under policies relating to the strict nondisclosure of company proprietary information.

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